Agricultural Economics & Economics Dept.

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THE IMPACT OF WHEAT AND BARLEY
ON THE MONTANA ECONOMY:
AN INPUT-OUTPUT APPROACH

by

G.W. Brester, M.D. Faminow and E.I. Benson

A Report Prepared Under Contract for the
Montana Wheat Research and Marketing Committee

Montana State University
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Executive Summary

Wheat and barley are Montana's primary grain crops and contribute substantially to cash receipts from agricultural production in Montana. Due to the importance of agricultural production (wheat and barley production, in particular) to Montana's current economic structure, it is clear that the future development and expansion of the Montana economy will depend, in part, on the performance of the grain sector. There are several reasons for this. First, Montana has a comparative advantage in wheat and barley production. These crops have been a large component of Montana's economic base in the past, and will continue to contribute directly to the state's economic growth in the future. Second, the linkages between wheat and barley production and other sectors of the economy are substantial. Expansion of the wheat and barley industry will lead to output increases in other sectors of the Montana economy which, in turn, lead to higher levels of state income.

This analysis utilizes an input-output model of Montana to evaluate the structure of the Montana economy and describe the impact of the wheat and barley sectors on the rest of the economy. An input-output model is a system of equations that describes the intersectoral flows of goods and services in an economy. A primary benefit of utilizing input-output methodology is that it permits a detailed analysis of the impacts on various sectors of the economy which result from exogenous changes to one (or more) sectors.

On a statewide basis, the wheat and barley sectors purchase inputs from many different sectors. For ease of illustration here (but not in the full report), consider the input purchases per dollar of output from other sectors of Montana's economy aggregated to ten general categories. With a

one dollar increase in production, Montana wheat producers directly purchase approximately: 9 cents from other agricultural producers; 1 cent from the Agricultural services, forestry, and fisheries sector; 1 cent from the Mining sector; 1.5 cents from the Construction sector; 9 cents from Manufacturing; 2 cents from Transportation and public utilities; 3.5 cents from the Wholesale sector; less than 1 cent from the Retail trade sector; 14 cents from the Finance, insurance, and real estate sector; and 1 cent from the Service sector. On a national basis these sectoral purchases are larger. However, since Montana relies on out-of-state sources for many inputs, the direct purchases of most inputs are lower than the national levels.

Purchases of inputs per dollar of barley produced are quite similar. A one dollar increase in barley output would result in direct purchases from other Montana sectors of: 8 cents from other agricultural producers; 1 cent from Agricultural services, forestry, and fisheries; 1 cent from Mining; 1 cent from Construction; 10 cents from Manufacturing; 3 cents from Transportation and public utilities; 5 cents from the Wholesale sector; less than 1 cent from the Retail trade sector; 9 cents from Finance, insurance, and real estate; and 1.5 cents from the Service sector.

Although these input requirements for wheat and barley are expressed in a per dollar of output basis it is a simple matter to extrapolate to larger increases in production by multiplying through with the appropriate increase in production. For example, to determine the direct input requirements of a 10 million dollar increase in wheat production, one only needs to multiply each of the input requirements (per dollar of output) by 10 million.

These figures, while useful for discussing the input structure for wheat and barley, understate the aggregate impact of increases in wheat and barley production on the Montana economy. Each input sector will require, in turn, additional inputs from other sectors. Thus, stimulation of the grain sector causes a series of "ripples" throughout the rest of the economy. Finally, incomes will be enhanced in each of the affected sectors, leading to increased levels of consumer spending and still more economic impacts.

The aggregate total of all these impacts can be measured by impact multipliers. Whereas, many different multipliers can be calculated from input-output models, the two most commonly calculated multipliers are the output and income multipliers. The output multiplier indicates the direct, indirect, and induced output effects on the economy as a result of a change in the output of a sector. Output multipliers were calculated for Montana wheat and barley production as 1.84 and 1.83, respectively. These multipliers may be interpreted as indicating a one dollar increase in the output of wheat (barley) generates an additional 84 (83) cents of output in the rest of the economy. Similarly, the income multipliers for wheat and barley were calculated as 2.28 and 2.18, respectively. Income multipliers provide a measure of the direct, indirect, and induced income effects resulting from an exogenous disturbance on the state economy. They may be interpreted as indicating that a one dollar increase of income in the wheat (barley) sector generates an additional 1.28 (1.18) dollars of income in the rest of the economy.

In addition to describing the structure of the state economy and allowing the calculation of multipliers, the Montana Input-Output Model can also be used to simulate the impacts of various exogenous shocks. Included

within this study are analyses describing the simulated impacts of: (1) an exogenous 10 percent increase in the demand for Montana wheat and barley; (2) government acreage reduction programs (diversion, payment-in-kind); and (3) the establishment of a major Montana beef packing facility on the state grain sector. The input-output study, supported by the results of these simulations, demonstrates conclusively that the wheat and barley sectors are vitally important to the Montana economy as a whole. Changes which impact these sectors significantly are transmitted, through intersectoral linkages, through the entire state economy.

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Chapter 1

Introduction

The production and sale of grain crops have substantial impacts on the Montana economy. In 1982 (latest available), for example, cash receipts for wheat and barley were 755 million dollars and 117 million dollars, respectively. However, cash receipts from marketed grain are only a relatively small indicator of the overall importance and impact of these crops on the Montana economy. There are linkages between the grain sector and other sectors of the Montana economy which mean that the direct benefits of income to grain producers are multiplied through the economy as that income is spent. The linkages (inter-sectoral relationships) include: (1) the purchase of production inputs like seed, machinery, fuel, labor, etc.; (2) the sale and marketing of grains which requires the services of marketing industries such as transportation and grain elevators; and (3) the purchases of goods and services for consumption by farm households. The income generated by these farm sector purchases have linkage and multiplier effects of their own. In order to determine the total impact of the wheat and barley sectors on the state economy, one must trace the effects of production from the sector throughout the rest of the economy.

The Montana Wheat Research and Marketing Committee provided funding for a two-stage economic research project, the objectives being: (1) to determine the total impact of wheat and barley production on Montana's economy, and (2) to determine the impact of wheat and barley on Montana communities. This report describes the first stage of the project. It details the work completed from July 1983 to June 1984 which has specified the statewide impacts of the wheat and barley sectors, including the

sectors' impacts on other sectors of the Montana economy. Stage II of the research project, scheduled for July 1984 to June 1985, will delineate similar results for specific categories of communities in the state.

Available techniques for achieving the stage I objectives include export base, econometric, and input-output models. The input-output (I-O) approach was chosen for this study because experts on the subject of determining impact multipliers and intersectoral linkages consider I-O to be the preferred method -- yielding the most detailed and useful results. Input-output analysis is an empirical technique for describing and analyzing the flows of goods and services within an economy. An attractive feature of I-O is that it contains sufficient detail to illustrate the process through which changes in one sector affect other sectors, in addition to detailing the aggregate impact on the state economy. The multiplier or "ripple" effects can be measured to determine the impact of potential exogenous shocks or changes in the grain sector on the rest of the state economy. The next two chapters provide the theoretical underpinnings of I-O analysis and a simple example of its uses and implications.

A statewide I-O model was developed as a first step toward achieving the objectives of the research project. This model, described in detail in Chapter 4, characterizes the linkages between 494 sectors of the Montana economy. The base data necessary for constructing the Montana I-O model were purchased from the Regional Science Research Institute. This Institute had sufficient data available to develop a large working I-O model for Montana within the financial and time limits of the project. The data were used to describe and quantify the relationships in terms of the flows of goods and services between sectors of the Montana economy. The solution of the I-O model to obtain impact multipliers for the grain sector is described

in Chapter 5. Impact multipliers measure the total impact of an exogenous shock of a particular sector on the state economy. These impacts are also traced through the other sectors of the state economy. Finally, selected exogenous changes which impact the wheat and barley sectors are analyzed, along with their impact on the state economy, and the results described in Chapter 6. This analysis provides insights as to how the complexion of the state economy, generally, and the grain sectors, specifically, are altered with changes that affect the grain producing sectors.

Stage II of this research project, to be undertaken within the next year, will employ the I-O model developed this year and described in the following chapters. Montana communities will be classified into a number of typical categories, according to the level of the community in a spatial hierarchy of trading centers. The portion of total expenditures made by grain growers in each type of community will be estimated. The statewide I-O model can then be adjusted to estimate community specific multipliers and linkages, similar to the statewide values reported here. This approach to exploring the impact of wheat and barley on the economy of Montana communities is superior to the alternative method of performing case studies because differential impacts are expected up and down the spatial hierarchy. Furthermore, all the linkages in the state are captured in the statewide model, so all that is required is determination of the portion of a particular linkage that is relevant for a particular kind of community. This "top-down" methodology is far less costly and provides more applicable results than a "bottom-up" procedure where many individual communities are studied in order to determine aggregate impacts.

Thus, this report on stage I of the research project is divided into six chapters beyond this introduction. Chapter 2 provides a detailed

examination of input-output theory, and Chapter 3 illustrates the workings of an I-O model by developing a simple numerical example. The Montana I-O model is described in Chapter 4 and the general solution of the Montana model is delineated in Chapter 5, while the impacts of specific exogenous shocks to the grain sector and the Montana economy are simulated in Chapter 6. Concluding observations appear in Chapter 7.

Chapter 2

Input-Output Theory[1]

General Description of Input-Output Analysis

Input-Output analysis is a commonly used empirical tool of regional economics -- that subdiscipline of economics which combines economic theory with the problems associated with regional income levels, growth, and development. This chapter develops the theoretical underpinnings of I-O analysis.

Input-output analysis is a method of classifying, describing, and analyzing the flows of goods and services in an economy. That is, it is a method of accounting for the inputs to and outputs from each sector of an economy (hence the term "input-output"). These input-output relationships are expressed as a large system of equations that describes the sales of goods and services between the sectors of the economy in a general equilibrium framework.

The primary virtue of I-O theory is that it is based on this principle of general equilibrium. That is, it considers the economic interdependence of *all* the various sectors of an economy as opposed to partial equilibrium which focuses on a *single* sector. Thus, for instance, an increase in the demand for the output of one industry can be shown to result in successive changes in the demand for the output of other industries, especially those which supply inputs to the former. Input-Output analysis explores the employment, output, value added, and income impacts which result from exogenous disturbances to the economy, where an exogenous disturbance is defined as a change in final demand for the output of one (or more) industries.

The Transactions Table

Many different I-O models exist with each designed to address one or more specific aspects of the economy which it is intended to approximate. However, all models have a common denominator in that each may be represented by some form of transactions table. The transactions table is a tabular form of the coefficients in the underlying system of equations.

The construction of a transactions table requires a prodigious amount of labor. Most of the work involves the gathering of data. The basic data that must be gathered concerns interindustry relationships, i.e. the amount of inputs that one industry purchases from another in order to produce its output. Data from single-product firms is the easiest to gather. In general, information concerning cash flows is the essential element that is required to build a table. This information includes such items as revenue and expense accounts by commodity and the sources and applications of investment funds.

Multi-product firms present additional problems for the researcher. A decision must be made concerning the sectoral designation of such firms. For example, a firm that produces three commodities can either be categorized by its dominant commodity, or separated into three different sectors. The latter method is much more difficult than the former since data concerning revenue and expense items by commodity are often difficult to obtain.

There are several methods in which the required data can be gathered. Survey methods involve contacting every industry to discover their purchases and sales to other industries. This method is often regarded as most accurate and is also the most costly. Another technique often used is to develop data based on a sample of each industry. This method is primarily

used to identify input relationships which are then supported with data from secondary sources. Sampling is less costly than surveying. However, errors in data can occur due to sampling problems within industries. Finally, data for constructing a transactions table may be gleaned from secondary sources, i.e. data that has been already gathered and published. This method is probably the most popular because it is the least costly of the three. The major disadvantage is that available data may not correspond to the researchers desired level of disaggregation.

A simplified version of an I-O transactions table is presented in Figure 2.1. Even though the figure depicts a highly aggregated transactions table, it does illustrate the essential components. The values in each of the rows of the processing sector represent the sales of industry i ($i = 1,2,\ldots,n$) to each of the j ($j = 1,2,\ldots,m$) industries.[2] These interindustry interactions are considered intermediate demand. Each row also illustrates the addition to inventories (A) and the sales of each i industry to private investment (I), exports (E), government purchases (G), and households (H) (consumption) which together form final demand. Therefore, gross output of each industry can be measured in an n sector economy as

$$X_i = \sum_j^m X_{ij} + (A_i + I_i + E_i + G_i + H_i) \ . \tag{2.1}$$

Conversely, each element of the j column illustrates the purchases of industry j from the respective i industries. Purchases are also made by industries from other sectors. The inventory depletion (T) row shows the use of accumulated stocks in the production of goods. The absorption of these stocks is treated as a use of a primary input. The imports (M) row shows the amount of imports purchased by the j industries and other sectors.

INPUTS \ OUTPUTS		PROCESSING SECTOR					FINAL DEMAND					TOTAL GROSS OUTPUT
		1	......	j	......	m	INVENTORY ACCUMULA-TION	PRIVATE INVESTMENT	EXPORTS	GOVERNMENT PURCHASES	HOUSEHOLDS	
PROCESSING SECTOR	1	X_{11}	•	X_{1j}	•	X_{im}	A_1	I_1	E_1	G_1	H_1	X_1
	•	•		•		•	•	•	•	•	•	•
	•	•		•		•	•	•	•	•	•	•
	•	•		•		•	•	•	•	•	•	•
	i	X_{i1}	•	X_{ij}	•	X_{im}	A_i	I_i	E_i	G_i	H_i	X_i
	•	•		•		•	•	•	•	•	•	•
	•	•		•		•	•	•	•	•	•	•
	•	•		•		•	•	•	•	•	•	•
	n	X_{n1}	•	X_{nj}	•	X_{nm}	A_n	I_n	E_n	G_n	H_n	X_n
PAYMENTS SECTOR	INVENTORY DEPLETION	T_1	•	T_j	•	T_m	--	T_I	T_E	T_G	T_H	T
	DEPREC-IATION	D_1	•	D_j	•	D_m	--	D_I	--	--	D_H	D
	IMPORTS	M_1	•	M_j	•	M_m	M_A	M_I	--	M_G	M_H	M
	PAYMENTS TO GOV'T	P_1	•	P_j	•	P_m	P_A	P_I	P_E	P_G	P_H	P
	HOUSE-HOLDS	L_1	•	L_j	•	L_m	L_A	L_I	L_E	L_G	L_H	L
TOTAL GROSS OUTLAY		X_1	•	X_j	•	X_m	A	I	E	G	H	X

Figure 2.1. A General Transactions Table

A row representing payments to the government (P) in the form of taxes is included to correspond to the government purchases column. Many "closed" I-O models include households (L) as part of the interindustry matrix which, consequently, cause consumption to be treated as a function of autonomous changes in income.[3] The depreciation (D) row considers the cost of plant and equipment that is used in the production process.

Summing down each j column yields

$$X_j = \sum_{i}^{n} X_{ij} + (T_j + D_j + M_j + P_j + L_j). \tag{2.2}$$

The economy's total gross output can be found by summing across the totals row and down the totals column which yields

$$X = \sum_{j}^{m} X_j + A + I + E + G + H, \tag{2.3}$$

and

$$X = \sum_{i}^{n} X_i + T + D + M + P + L. \tag{2.4}$$

Since

$$\sum_{j}^{m} X_j = \sum_{i}^{n} X_i, \tag{2.5}$$

the intermediate flows are cancelled out. Thus, equations 2.3 and 2.4 are reduced to

$$T + M + P + L + D = A + I + E + G + H. \tag{2.6}$$

It is convenient to consider T, P, and D as components of value added (V) and both A and H as components of consumption (C). Rewriting equation 2.6 using these new variables results in

$$L + V + M = C + I + G + E . \tag{2.7}$$

By moving imports (M) to the right hand side of the equation, the traditional macroeconomic accounting identity is obtained

$$\underset{\text{Gross Regional Income}}{L + V} = \underset{\text{Gross Regional Product}}{C + I + G + (E - M)} . \tag{2.8}$$

The sum of all income payments by the productive system is equal to the total value of goods and services purchased by the final demand sectors.

The solution of the I-O model presented in Figure 2.1 can be more easily explained with a simplification. This is done by aggregating the final demand accounts into a single column vector, Y. The payments sector is aggregated and represented by a single row vector, V.

Summing across each row and rearranging terms yields

$$X_i - \sum_{j=1}^{m} X_{ij} = Y_i \qquad (i = 1,\ldots.n). \tag{2.9}$$

At this point, a crucial assumption is necessary. It is assumed that the value of goods and services sold by industry i to the other j industries is a linear function of the output level of the j sectors. This assumption allows equation 2.9 to be rewritten as

$$X_j - \sum_{j=1}^{m} a_{ij}X_{ij} = Y_i \qquad (i = 1,\ldots.n), \tag{2.10}$$

where

$$a_{ij} = \frac{X_{ij}}{X_j} \qquad (i = 1,\ldots.n)(j = 1,\ldots.m).$$

Each of the a_{ij}'s is considered a technical coefficient in that they describe the output of any i sector per unit of output from any j sector.

Input-Output analysis considers the interaction of three main components of an economy; final demand, gross output, and the input requirements of each industry. Assuming the technical coefficients remain stable over time allows for a relationship to be established between final demand and gross output. Herein lies the purpose of I-O analysis -- that is, to measure both the direct and indirect effects of changes in final demand on gross output.

The Leontief inverse matrix is used to measure not only the direct effects of an exogenous change in final demand, but also all of the higher order effects. This mechanism is most clearly demonstrated by using matrix notation to describe the I-O system. Equation (2.10) can be rewritten in general matrix form as

$$X - AX = Y, \tag{2.11}$$

where X and Y are (n x 1) column vectors of gross output and final demand, respectively, and A is a n x m matrix of the technical coefficients. Using the following identity matrix (I),

$$\begin{bmatrix} 1 & 0 & 0 & \cdot & 0 \\ 0 & 1 & & & \cdot \\ \cdot & & \cdot & & \cdot \\ \cdot & & & \cdot & \cdot \\ 0 & \cdot & \cdot & \cdot & 1 \end{bmatrix}$$

equation (2.11) can be written as

$$(I-A)X = Y . \tag{2.12}$$

Assuming that (I-A) is nonsingular, gross output can be expressed as a function of final demand:

$$X = (I-A)^{-1}Y . \tag{2.13}$$

The matrix $(I-A)^{-1}$ is the Leontief inverse matrix. Defining $(I-A)^{-1}$ as B, equation (2.13) can be rewritten as

$$X = BY . \tag{2.14}$$

Each coefficient of B, i.e. b_{ij}, represents the direct and all of the indirect requirements of each sector i per unit of final demand for the output of sector j such that

$$X_i = b_{i1}Y_1 + b_{i2}Y_2 + \ldots + b_{ij}Y_i + b_{ij}Y_j + \ldots + b_{in}Y_n . \tag{2.15}$$

Multiplication of the inverse matrix B by any type of change in final demand allows us to analyze the total impact of exogenous disturbances on the

various sectors of the economy. For example, denoting the new final demand vector, given some change in final demand, as Y* the effect of a change in final demand on output will depend on the coefficients of the B (Leontief inverse) matrix. Writing X* as the new output matrix, this may be expressed in matrix form as

$$X^* = BY^* . \tag{2.16}$$

Thus, a change in final demand results in a new final demand vector (Y*) which, in turn, is translated into a revised output matrix (X*) through the coefficients of the Leontief inverse matrix (B). Therefore, the key in developing the I-O model is to estimate the technical coefficients -- the a_{ij}'s that describe the output of any industry i in terms of output from the jth sector. Using these coefficients, development of the Leontief matrix is a simple computational problem for modern computers.

Multiplier Analysis

The most commonly used result of input-output analysis is the impact multiplier. Although multiplier analysis is commonly linked to I-O theory, the concept has a long history of development in macro-economic theory. John Maynard Keynes was one of the first economists to develop and utilize impact multipliers as aggregate measures of income and employment. In his General Theory, Keynes hypothesized that each consumer spends some portion of an income increase, while saving the remainder. The amount spent by the consumer eventually accrues to other consumers who, in turn, spend some fraction of it. By measuring the proportion spent each successive "round", Keynes could calculate what he termed "the marginal propensity to consume." From that measure, the income multiplier is estimated. The total impact of any change in income can be found by multiplying the change by the income multiplier.

The use of an aggregate multiplier is especially pertinent when trying to estimate the overall effects of a change in final demand. However, economists, businessmen, and politicians are frequently interested in estimating the impact of a change in final demand on specific industries. For example, the result of a change in national farm programs upon the U.S. economy may be estimated by using an aggregate multiplier. However, such changes may impact the agriculture sector differently than the fertilizer manufacturing or transportation sectors. In turn, changes in each of these sectors causes different impacts upon others. Therefore, because of differences in interindustry linkages, it is important that multipliers be developed for each sector of an economy in order to evaluate the impact of a change in final demand on a specific sector.

Input-output models allow for the disaggregation of the Keynesian multiplier. Specifically, it is possible to define and develop multipliers for each sector of an economy. Using I-O, output, employment, income, and value added multipliers can be estimated for each sector.

Some caution should be exercised when using or interpreting multipliers. This is necessary because of the common fallacy of assuming the existence of a unique multiplier. Actually, there exists a variety of multipliers with each calculated in a different manner and used for a specific purpose (for a discussion of output, income, employment, and value added multipliers, see the next section). It is also incorrect to directly compare the sizes of multipliers (even those of the same category) from two different economies since relative sector sizes and numbers of sectors will influence the magnitude of multipliers. In addition, multipliers for completely self-contained or "closed" economies tend to be larger than those

for a regional economy. This is because a closed economy has fewer "leakages" in the way of imported goods and services.

Output, Income, Employment, and Value Added Multipliers

There are two broad categories of multipliers: Type I and Type II multipliers. A Type I multiplier includes both the direct and indirect effects of an exogenous disturbance in final demand. The direct effect can be described as the actual disturbance of a sector; in other words, the direct effect of a change in output from expansion or contraction of one (or more) sectors. The indirect effects are those changes in other sectors which occur because the directly affected sector (or sectors) will change its demands for goods and services (inputs) produced by others. Since each sector of an economy relies on other sectors for inputs, expansion or contraction in the output of that sector will change the amount of inputs purchased from other sectors.

A Type II multiplier includes the direct, indirect, and induced effects of changes in final demand. The induced effects are those repercussionary effects of changes in consumer spending as a result of the direct and indirect effects altering consumer incomes. Since the expansion (contraction) in economic activity will change consumer income, a series of ripple effects due to enhanced (or decreased) income will also effect the overall level of spending, and hence output, in the economy. Therefore, a Type II multiplier is calculated by "closing" the I-O matrix with regards to households and calculating a new Leontief inverse matrix, B*. Specifically, for the purpose of calculating a Type II multiplier, the households row and column must also be included in the technology matrix.

Output Multipliers

An output multiplier for industry i estimates the total requirements from all sectors that are required for sector i to deliver one dollar of output to final demand. A Type I output multiplier is defined as the quotient of the total output (direct and indirect effects) and the direct output (output generated by the initial change in final demand). It is calculated for any j sector by summing the entries of the j column of the Leontief inverse matrix (B), such that

$$\sum_{i=1}^{n} b_{ij} \qquad (j = 1,\ldots m), \tag{2.17}$$

where b_{ij} is an element of the "open" Leontief inverse matrix, B.

A Type II output multiplier is equivalent to the Type I multiplier except that it includes the induced output in the numerator. The Type II output multiplier can be expressed as

$$\sum_{i=1}^{n-1} b^{*}_{ij} \qquad (j = 1,\ldots m), \tag{2.18}$$

where b^{*}_{ij} is an element of the "closed" Leontief inverse matrix, B*. The product of the Type II output multiplier and any change in final demand for a given sector will yield the total change in production of that sector needed to deliver the given amount of final demand. The main virtue of an output multiplier is as an indicator of interdependencies between each sector and the entire economy.

A cautionary note concerning the Type II output multiplier is appropriate at this time. The Type I output multiplier was calculated by summing all of the elements in the j column of the Leontief inverse matrix. The Type II output multiplier is found by first closing the model so as to include the households sector, and then resolving the system of equations.

However, the elements contained in the households sector should not be included in calculating the multiplier (Johnson and Kulshrestha). In effect, this would constitute double counting and thus, an overstatement of the size of the induced effects. Similar problems do not surface in the calculation of income and employment multipliers.

Income Multipliers

A Type I income multiplier is calculated by dividing the direct and indirect income changes by the direct income change that results from a change in final demand. The direct and indirect income effects for sector j (see Figure 2.1) are found by multiplying its column coefficients of the inverse matrix by the corresponding row coefficients in the households column. Finally, all of these multiplications are summed. Mathematically, the direct and indirect effects of sector j are calculated by

$$\sum_{i=1}^{n} b_{ij} h_i \qquad (i = 1, \ldots n), \tag{2.19}$$

where b_{ij} is a coefficient of the Leontief inverse matrix (B) and h_i are elements of the households row vector.

The methodology for calculating a Type II income multiplier is completely analogous to that of a Type II output multiplier. It is the quotient of the direct, indirect, and induced income changes and the direct income change. The direct, indirect and induced effects for each sector are the elements of the households row of the Leontief inverse matrix after the technology matrix has been augmented to include the households sector (i.e. closing the model to households). In this way, the repercussionary effects of increases in consumer spending which results from the direct and indirect effects are included in the multiplier.

A third type of income multiplier can be identified. This Type III income multiplier is calculated after relaxing some of the restrictive assumptions used to determine the Type II multiplier. Specifically, the assumptions that the underlying consumption function is both linear and homogeneous are modified. This procedure is accomplished by first estimating non-linear consumption functions. Then, the additional income which accrues to existing households due to a change in final demand must be distinguished from that which accrues to new households. This Type III multiplier calculates the induced effects that result from a change in final demand more accurately than the Type II multiplier. Therefore, the Type III multiplier is less likely to overestimate the actual effects, on income, of an exogenous shock to the economy.

Employment Multipliers

In many cases an input-output analyst may be more interested in the employment effects of a change in final demand than the income or output effects. This is particularly true for regions that are attempting to attract new industrialization and are concerned with projecting potential employment changes.

Different techniques have been developed to estimate employment multipliers. Isard and Kuenne developed a method to estimate the total employment impact which would result from the introduction of a new industry into an area. The Isard-Kuenne methodology was developed for a particular case using a limiting set of assumptions tailored to a specialized area.

Moore and Peterson devised a technique for estimating employment multipliers that involves the development of linear employment-production functions estimated with linear regression techniques. Their method can

only be used in conjunction with a regional I-O model. However, it is a more general technique for estimating sectoral employment multipliers.

The first step of this procedure is to estimate functions

$$E_i = \alpha + \beta X_i + e_i, \tag{2.20}$$

where E_i equals employment, X_i equals output and e_i is an error term, each for the ith sector. The slopes of the employment-production functions are given by the estimates of β, i.e. $\hat{\beta}$. Therefore, the direct employment change on any j sector resulting from a change in final demand is measured by the slope of its estimated employment-production function, $\hat{\beta}_j$. The direct and indirect employment changes on sector j are calculated by multiplying the quotient from E/X for each $\hat{\beta}_i$ by the total direct and indirect requirements from each sector i for one dollar of final demand to sector j. Summing these products yields

$$\sum_{i=1}^{n} b_{ij}\hat{\beta}_i \qquad (j=1,\ldots,n), \tag{2.21}$$

where b_{ij} equals the coefficients of the inverse matrix. The Type I employment multiplier is calculated by dividing the total direct and indirect employment effects of a change in final demand by the direct employment effects.

The deviation of the Type II employment multiplier is analogous to that of the Type II income multiplier. The Type II employment multiplier measures the direct, indirect, and induced employment effects as a ratio of the direct employment effects. Mathematically, the Type II employment multiplier for any j sector is given by

$$\sum_{i=1}^{n} b^{*}_{ij}\hat{\beta}_i \qquad (j=1,\ldots,n), \tag{2.22}$$

where b^{*}_{ij} equals the elements in the augmented (closed) inverse matrix.

Value Added Multipliers

The concept of "value added" is very important in regional (see the following section) I-O models because it is the proper measure of gross regional product. The total value of the output of a region's sales is an incorrect measure of the region's production. This is because most industries purchase inputs, process them, and then sell the output. The proper measure of production for these industries would be the value that is added during the production process. Measuring regional product in terms of the value of gross sales would result in double counting the value of the inputs used during production.

The Type I value added multiplier is equal to the ratio of the direct and indirect value added effects of a change in final demand to the direct effects. Once again, the direct and indirect effects are calculated from the Leontief inverse matrix for an "open" economy.

The Type II value added multiplier is a more correct measure of changes in value added. It is the ratio of the direct, indirect, and induced effects to the direct effects which result from an exogenous disturbance to the economy. The direct, indirect, and induced effects are calculated from the Leontief inverse matrix for the "closed" (with respect to households) economy.

Regional and Interregional Models

The previous discussion of this chapter has focused its attention on a general equilibrium model designed to identify and analyze interindustry dependencies within the framework of a single national region. However, it

has become increasingly important to be able to analyze the effects of exogenous disturbances on a regional (subnational) basis. Most applied I-O studies have centered on regional models which are smaller versions of an existing national model. This procedure of "regionalization" requires that an assumption be made concerning input patterns. Specifically, it is often assumed that the input-mix and product-mix of a region are the same as for the nation. This problem is minimized, though not completely resolved, when using a highly disaggregated transactions table.

A regional model is partial equilibrium analysis in the sense that it only considers the effects of economic impacts on a particular study region. This study region may be defined as a large area the size of the western portion of the United States, down to a small area the size of a small city. Regional studies have also defined study areas in terms of a county, several counties, and a single state.

It was previously mentioned that regional I-O models closely resemble national models. However, there is one particular area in which this generalization does not apply. Regional models are usually more "open" than are national models. That is, imports and exports are a substantially greater proportion of a region's total transactions than of the transactions of a mostly self-contained national economy such as the U.S. This is because a single region's economy is more likely to have a higher degree of specialization than the economy of an entire nation. Consequently, a region is dependent to some extent upon other regions for imports and exports. Therefore, part of the multiplier effects are lost due to "leakages" from the region and, consequently, the values of multipliers for regions within a larger area are generally smaller than those for the entire economy.

Regional I-O models can be categorized into two basic types, each distinguished by the degree of aggregation of the import and export transactions. The "square" regional I-O model employs one or more highly aggregated columns and corresponding row or rows. Its I-O table is similar to the one depicted in Figure 2.1.

The "dog-leg" regional model considers a region's imports and exports by disaggregating each according to industries and sectors. The import row and export column is removed from the original transactions table. An export table is then added to the right of the transactions table to illustrate export transactions occurring in each industry and sector as illustrated in Figure 2.2. The import transactions for each industry and sector are represented by an import matrix which is appended directly below the transactions table. The dog-leg model allows for detailed observation of the structural interdependencies between the region and industries outside the region. However, only the endogenous transactions table (the original table excluding imports and exports) can be inverted to show the total effects of an exogenous disturbance. Therefore, the import and export matrices are usually collapsed into a single row and column, respectively, before the transactions table is inverted.

One criticism of regional I-O analysis is that it deviates from the primary virtue of I-O models -- as a tool for analyzing general equilibrium. A regional I-O model fails to consider the impacts of changes of a region's economy on those of other regions. Consequently, the resulting repercussions of interregional economic feedbacks on a study area are not measured. Some argue that in order to consider regional I-O models as a method of analyzing general equilibrium, an interregional model must first

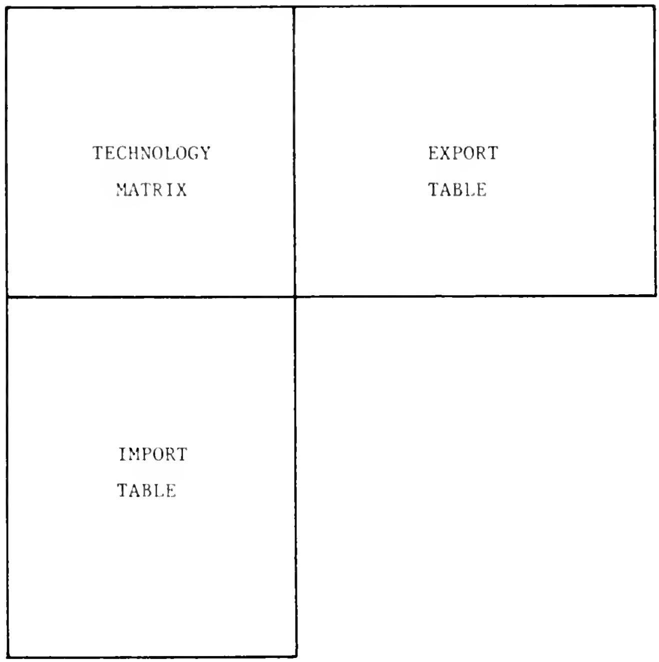

Figure 2.2. A "Dog-Leg" Regional Input-Output Table.

be developed. The primary constraint to the development of such a model is the difficulty in measuring interregional trade flows.

There are two types of interregional models -- a "balanced" regional model and a "pure" interregional model. The difference between the two is embodied in the methods used to construct each. A balanced regional model is developed by disaggregating a national I-O model into the desired regional components. This is generally called the "top-down" methodology because it involves developing a system of linked regional models based on one national I-O model. Alternatively, a pure interregional model is constructed by aggregating a number of regional I-O models. In this "bottom-up" approach, regional I-O tables are first developed independently and then aggregated into an interregional model. In both cases, the development and use of interregional models is vastly more complex than a single national or regional model. The complexity arises because, in addition to the consideration of interindustry interdependencies, interregional interdependencies and trade flows must also be incorporated into the model.

Regional Purchase Coefficients

Another method of regionalizing a national model (and the one employed in this report) is to define a new set of coefficients specific to a region. These regional purchase coefficients (RPC) measure the proportion of a good or service that a region supplies to itself. This measurement is necessary because some of the effects resulting from an exogenous disturbance of final demand will be exported from a region. Purchases of imported goods and services "leak" out of the region. These purchases are, therefore, not available to generate new direct, indirect, and induced income, employment,

or output because they have exited the regional economy. Of course, the greater the amount of the "leakage," the smaller will be the indirect and induced effects of a change in final demand.

It is assumed that the economies of regions which supply imports are not interdependent with that of the study area. This assumption that other regions do not have feedback into the study area is probably incorrect in most cases. However, to assume otherwise would require extensive research to determine interregional flows of goods and services. In fact, this would require the development of an entire interregional model as previously discussed. The assumption of a lack of interregional interdependencies may be rigid, but amounts to a conservative estimate of the impacts of a change in final demand on the regional economy. Regional purchase coefficients may be derived from using either survey or non-survey techniques. Our estimation of RPC's using the latter method will be discussed in Chapter 4.

Notes

1. The authors do not claim any originality of the material presented in this chapter. The chapter, is a brief review of Input-Output theory and draws heavily upon the writing of both Miernyk and Richardson.
2. Throughout this section the words "sector" and "industry" are used interchangeably.
3. The term "closed" refers to an I-O model that includes one or more of the final demand (payments) sectors in the interindustry matrix. The inclusion of households in this matrix is commonly done. The degree to which any model is "open" or "closed" depends largely upon the purpose for which it is to be used. The differences between "open" and "closed" models will be delineated in Chapter 3.

Chapter 3

A Numerical Example

A generalized input-output model was presented in mathematical form in Chapter 2. However, the basic concepts of I-O analysis may be better illustrated through the use of a simplified numerical example. This chapter develops such an example with a highly aggregated I-O model. It is important to remember throughout this chapter that the example being presented is for illustration purposes only, as it is based purely on hypothetical numbers that are not intended to represent an actual economy in any way. Our primary purpose is to illustrate some of the basic principles of I-O analysis to readers that are unfamiliar with I-O theory or mathematics.

A Hypothetical "Open" Transactions Table

A hypothetical transactions table is presented in Figure 3.1. The processing sector consists of only two industries -- labeled agriculture and manufacturing. The final demand sector is represented by the households column and by a highly aggregated column representing all other final demand. Each of the columns of the transactions table has a corresponding row vector. The elements of each row describe the sales of that particular sector to the corresponding column sector. For example, the first row shows that agriculture sells $30 of its output to itself and $50 to the manufacturing sector. In addition, $80 of output is sold to households and $40 to the other components of final demand. The total output of agriculture is shown in the last column. The other rows can be interpreted in an analogous fashion.

SALES TO → / PURCHASES FROM ↓		PROCESSING SECTOR		FINAL DEMAND		GROSS OUTPUT
		AGRI-CULTURE	MANU-FACTURING	HOUSEHOLDS	OTHER FINAL DEMAND	
PROCESSING SECTOR	AGRI-CULTURE	30	50	80	40	200
	MANUFAC-TURING	60	80	90	70	300
HOUSEHOLDS		30	70	20	80	200
OTHER VALUE ADDED		80	100	10	-	190
GROSS OUTLAY		200	300	200	190	890

Figure 3.1. A Transactions Table for a Hypothetical Open Economy.

Each column of the transactions table illustrates the value of inputs that a sector purchases from others to produce its output. For example, the second column of the transactions table indicates that the manufacturing sector purchases $50 of its inputs from agriculture, $80 from itself, $70 from households (e.g. labor services), and $100 from other sources. The other columns can be interpreted in a similar manner. The last entry in each column shows the total purchases made by each sector to produce its output. As expected, the column totals are equivalent to the row totals. This indicates that the value of gross output is equal to the value of all inputs (including value added) to the production process.

This hypothetical I-O model is an "open" model because the households sector is treated as a component of final demand, i.e. the households row and column are not included in the processing sector. An I-O model that is open with respect to households allows for the calculation of direct and indirect effects of an exogenous change in final demand. However, as we will later see, the calculation of induced impacts requires the use of a closed model.

Technical Coefficients and Multipliers

A technical coefficient describes the inputs required from each industry to produce a unit of output for a given industry. Consequently, technical coefficients are derived only for the processing sector. The technical coefficients for each industry are calculated by dividing the entries in each column by the gross output of each industry. Figure 3.2 illustrates the direct input coefficient matrix for the hypothetical economy. Note that technical coefficients can be presented in either physical or, as in this case, monetary units.

$$
\begin{array}{lcc}
 & \underline{\text{Agriculture}} & \underline{\text{Manufacturing}} \\
\underline{\text{Agriculture}} & \left[\begin{array}{c} \dfrac{30}{200} = 0.15 \\ \\ \dfrac{60}{200} = 0.30 \end{array}\right. & \left.\begin{array}{c} \dfrac{50}{300} = 0.17 \\ \\ \dfrac{80}{300} = 0.27 \end{array}\right] \\
\underline{\text{Manufacturing}} & &
\end{array}
$$

Figure 3.2. The Direct Input Coefficient Matrix of the Hypothetical Open Economy.

The technical coefficients measure the direct input requirements of an industry in response to each dollar change in final demand. For example, each one dollar increase in final demand for agricultural products will result in a direct effect of increasing agricultural input requirements by 15 cents. In addition, the one dollar increase would result in an increase agriculture's demand for inputs produced by manufacturing by 30 cents. Thus, the total direct effects on agriculture per one dollar increase in final demand for its output would be 45 cents. Agriculture would make direct purchases of inputs from both itself and other industries (in this case, manufacturing) in order to produce the additional output valued at one dollar. Of course, the effects of any sized increase in final demand can be calculated as a multiple of the effect of a one dollar change. For example, a one million dollar increase in final demand results in an aggregate direct effect of $450,000 ($150,000 for agriculture and $300,000 for manufacturing).[1]

This is not, however, the final impact on the economy as a result of a change in final demand for agricultural products. The additional inputs required by agriculture to produce additional output are produced by itself and by the manufacturing sector. An increase in the demand for those inputs will result in "second round" effects as the industries require additional inputs to increase production. Obviously, these changes in demand will continue to reverberate throughout the economy for many "rounds". The subsequent economic activity that results from the direct effects are called indirect effects and can be measured by use of the Leontief inverse matrix. The Leontief inverse is calculated by inverting the difference between an identity matrix and the direct input coefficient matrix.[2]

Figure 3.3 displays the Leontief inverse matrix for the hypothetical economy. Reading down the first column, every one dollar increase in the

final demand for agriculture will cause an increase in the output of agriculture of \$1.28 (including the original one dollar increase) and a \$.53 increase in manufacturing's output. Thus, the total direct and indirect output effects on the economy per one dollar change in the final demand for agriculture would be \$1.81. It is important to remember that this figure includes the original one dollar change.

Selected numerical results for this hypothetical I-O model are presented in Table 3.1. The Type I output multiplier for each industry is calculated by simply summing the elements of each respective column of the Leontief inverse matrix (Figure 3.3). Therefore, the Type I output multiplier for agriculture is 1.81 (1.28 + 0.53 = 1.81). The total value of the input requirements needed by agriculture to accommodate <u>any</u> change in final demand can be calculated by multiplying the specific change by 1.81. A larger multiplier would indicate a greater degree of economic interdependence of an industry with the economy.

It is worth noting that, while calculation of the Leontief inverse matrix is quite simple with small matrices such as the one employed in this example, it is difficult and costly even with the most sophisticated computers when the matrix is large. Thus, an alternative procedure for approximating the multipliers is often used in large I-O studies. Use of a Leontief inverse matrix generates the multiplier effects after an infinite number of "rounds" have occurred - that is after all the increasingly smaller and smaller indirect effects have occurred. However, the fact is that after ten or so rounds the remaining indirect effects that occur between round eleven and the infinite round are so small as to be virtually negligible. Thus, the multipliers can typically be accurately estimated by a round-by-round iterative procedure which totals up the direct and indirect

effects for the first several rounds and estimates the effects of the remaining rounds. (Miernyk, pp. 24-25).

Income multipliers are often a more interesting product of I-O analysis than output multipliers. A Type I income multiplier is the ratio of the direct and indirect income changes to the direct income change that result from a change in final demand. The calculation of the direct income effects requires returning to the original transactions table in Figure 3.1. The direct income effects resulting from a one dollar change in final demand for an industry's output are measured by the coefficient obtained by dividing the households row coefficient for an industry by that industry's output. Therefore, the direct income effects for agriculture per one dollar of output is \$30/\$200 or 15 cents and for manufacturing is \$70/\$300 or 23 cents. These are shown as the household row coefficient in Table 3.1.

The direct and indirect effects are found by summing the products of the particular industry's column elements of the inverse matrix by the corresponding household row coefficients. Thus, the direct and indirect income changes per one dollar change in final demand for agricultural products is (1.28 x 0.15) + (0.53 x 0.23) or 0.314. For manufacturing, the direct and indirect effects are (0.30 x 0.15) + (1.49 x 0.23) or 0.388.

The Type I income multipliers for each industry are presented in Table 3.1 and are calculated by dividing each industry's direct and indirect income changes by their respective direct changes (household row coefficients). Therefore, the direct and indirect income changes which result from any change in final demand for an industry are estimated by the product of the income multiplier and the original change in income which is caused by the exogenous disturbance of final demand.[3] Table 3.2 presents a summary of the calculation procedures for each multiplier.

$$\begin{array}{l c} & \begin{array}{cc} \underline{\text{Agriculture}} & \underline{\text{Manufacturing}} \end{array} \\ \begin{array}{l} \underline{\text{Agriculture}} \\ \underline{\text{Manufacturing}} \end{array} & \begin{bmatrix} 1.28 & 0.30 \\ 0.53 & 1.49 \end{bmatrix} \end{array}$$

Figure 3.3. The Leontief Inverse Matrix of the Hypothetical Open Economy.

Table 3.1. Numerical Results of the Hypothetical Open Economy.

	Agriculture	Manufacturing
Type I Output Multiplier	1.81	1.79
Household Row Coefficient	0.15	0.23
Direct and Indirect Income Change	0.314	0.388
Type I Income Multiplier	2.09	1.69

Numerical Results for a Hypothetical "Closed" Economy

The Type I multipliers presented above fail to consider the changes in consumer consumption levels which are "induced" by a change in final demand. When the demand for inputs increases, more income flows into households as the demand for household inputs (labor) increases. Thus, new "rounds" of changes in final demand occur. The total impact on the economy of the direct, indirect, and induced effects can be estimated by using Type II multipliers. Type II multipliers are calculated only after the model is "closed" with respect to households. The original transactions table (see Figure 3.1) is closed by augmenting the interindustry matrix by the households row and column. Figure 3.4 shows the hypothetical transactions table with the households sector endogenized. The next step is to calculate a new direct input coefficient matrix (Figure 3.5) using the same methodology as before. Then, a new Leontief inverse matrix is calculated and presented in Figure 3.6.

The Type II output multiplier is the ratio of the direct, indirect, and induced output changes to the direct changes. It is calculated by simply summing the column elements of each industry. The elements in the household column should be excluded to avoid double counting. These and other numerical results of the hypothetical closed economy are reported in Table 3.3. The Type II output multiplier for agriculture is 2.61 (1.62 + 0.99 = 2.61) and 2.78 (0.72 + 2.06 = 2.78) for manufacturing. The Type II output multipliers are larger than the Type I multipliers presented in Table 3.1. This is an anticipated result since the Type II multipliers include the additional induced effects caused by changes in consumer expenditures.

The Type II income multiplier is found in a similar fashion, i.e., it is the ratio of direct, indirect, and induced income effects to the direct

Table 3.2. A Summary of the Calculations of the Multipliers for the Hypothetical Open Economy.

Type of Multiplier	Multiplier Value	Mathematical Definition	Numerical Calculation
Type I Agriculture Output Multiplier	1.81	$OM_1 = \sum_{i=1}^{2} b_{i1}$	(1.28 + 0.53)
Type I Manufacturing Output Multiplier	1.79	$OM_2 = \sum_{i=1}^{2} b_{i2}$	(0.30 + 1.49)
Type I Agriculture Income Multiplier	2.09	$IM_1 = \frac{\sum_{i=1}^{n} b_{i1}h_i}{h_1}$	$\frac{(1.28 \times 0.15) + (0.53 \times 0.23)}{0.15}$
Type I Manufacturing Income Multiplier	1.69	$IM_2 = \frac{\sum_{i=1}^{n} b_{i2}h_i}{h_2}$	$\frac{(0.30 \times 0.15) + (1.49 \times 0.23)}{0.23}$

Note: b_{ij} = elements of the inverse matrix, B.

h_i = elements of the households row from the direct input coefficients matrix.

h_j = an element from the households row for the specific j column under consideration from the direct input coefficients matrix.

income effect. The latter is illustrated in Table 3.3 as the households row coefficient from the direct input coefficient matrix for the closed economy (Figure 3.5). The direct, indirect, and induced income effect for each industry is simply the coefficients of the households row in Figure 3.6. The total income change resulting from a change in final demand is estimated by the product of the income change as a result of the exogenous disturbance and the Type II income multiplier. Table 3.4 presents a summary of the procedures used to calculate each multiplier.

The empirical results obtained from the Montana I-O model that are presented in later chapters utilize the same general methodology as presented in this chapter. Except for the fact that the calculations are more extended due to the size of the actual transactions table, there is no major differences between the respective calculation procedures.[4] The actual computations were conducted on the MSU Honeywell CP-6 mainframe computer but, at least theoretically, they could be calculated (using the procedures outlined above) by hand.

SALES TO ➡ / PURCHASES FROM ⬇		PROCESSING SECTOR			FINAL DEMAND	GROSS OUTPUT
		AGRI-CULTURE	MANU-FACTURING	HOUSEHOLDS	OTHER FINAL DEMAND	
PROCESSING SECTOR	AGRI-CULTURE	30	50	80	40	200
	MANUFAC-TURING	60	80	90	70	300
	HOUSE-HOLDS	30	70	20	80	200
OTHER VALUE ADDED		80	100	10	–	190
GROSS OUTLAY		200	300	200	190	890

Figure 3.4. A Transactions Table for a Hypothetical Closed Economy.

$$
\begin{array}{l c}
 & \begin{array}{ccc} \underline{\text{Agriculture}} & \underline{\text{Manufacturing}} & \underline{\text{Households}} \end{array} \\
\begin{array}{l} \underline{\text{Agriculture}} \\ \underline{\text{Manufacturing}} \\ \underline{\text{Households}} \end{array} & \begin{bmatrix} 0.15 & 0.17 & 0.40 \\ 0.30 & 0.27 & 0.45 \\ 0.15 & 0.23 & 0.10 \end{bmatrix}
\end{array}
$$

Figure 3.5. The Direct Input Coefficients Matrix of the Hypothetical Closed Economy.

$$\begin{array}{l c} & \begin{array}{ccc} \underline{\text{Agriculture}} & \underline{\text{Manufacturing}} & \underline{\text{Households}} \end{array} \\ \begin{array}{l} \underline{\text{Agriculture}} \\ \underline{\text{Manufacturing}} \\ \underline{\text{Households}} \end{array} & \begin{bmatrix} 1.62 & 0.72 & 1.08 \\ 0.99 & 2.06 & 1.47 \\ 0.52 & 0.65 & 1.67 \end{bmatrix} \end{array}$$

Figure 3.6. The Leontief Inverse Matrix of the Hypothetical Closed Economy.

Table 3.3. Numerical Results of the Hypothetical Closed Economy.

	Agriculture	Manufacturing
Type II Output Multiplier	2.61	2.78
Households Row Coefficient	0.15	0.23
Direct, Indirect, and Induced Income Changes	0.52	0.65
Type II Income Multiplier	3.47	2.83

Table 3.4. A Summary of the Calculations of the Multipliers for the Hypothetical Closed Economy

Type of Multiplier	Multiplier Value	Mathematical Definition	Numerical Calculation
Type II Agriculture Output Multiplier	2.61	$TOM_1 = \sum_{i=1}^{2} b^*_{i1}$	1.62 + 0.99
Type II Manufacturing Output Multiplier	2.78	$TOM_2 = \sum_{i=1}^{2} b^*_{i2}$	0.72 + 2.06
Type II Agriculture Income Multipler	3.47	$TIM_1 = \frac{h^*_1}{h_1}$	$\frac{0.52}{0.15}$
Type II Manufacturing Income Multipler	2.83	$TIM_2 = \frac{h^*_2}{h_2}$	$\frac{0.65}{0.23}$

Note: b^*_{ij} = elements of the inverse matrix B*.

h^*_i = elements of the households row from the Leontief inverse matrix, B*.

h_j = an element from the households row for the specific j column under consideration from the direct input coefficients matrix.

Notes

1. Input-output models can differ in the specification of direct effects. Theoretically, the direct effects are usually calculated as in this example. However, in practice, it may be more appropriate to specify the direct impact as only the initial disturbance to a sector (in this example, the \$150,000 in agricultural). Any subsequent changes can be considered indirect effects, i.e. the \$300,000 change in manufacturing. The Montana Input-Output Model uses this alternative definition of direct effects. This will be further discussed in Chapter 5.

2. Recall from Chapter 2 that output can be expressed as:

$$X = AX + Y.$$

Solving for X (output) yields:

$$X = (I-A)^{-1}Y.$$

The Leontief inverse matrix is represented by the expression $(I-A)^{-1}$, where I is an identity matrix and A is the direct input matrix. Thus, subtracting the A matrix from the I matrix we are left with a new matrix (call it B, where B = I-A). This B matrix must now be inverted. An <u>inverse matrix</u> B^{-1} is a unique matrix that satisfies the relationship:

$$BB^{-1} = I = B^{-1}B.$$

Thus, multiplying a matrix by its inverse results in an identity matrix. Notice that the inverse matrix in matrix algebra performs a similar function as multiplying a number by its reciprocal in ordinary algebra. For a detailed discussion on methods of matrix inversion, see Chiang.

3. A common error accompanying the use of an income multiplier occurs when the estimate of a change in income is made by multiplying the income multiplier by the change in final demand rather than by the change in income due to a change in final demand.

4. A minor difference is discussed in footnote 1 above. Another is that a round-by-round iterative approach is used to estimate the impacts in place of directly calculating the Leontief inverse matrix, in order to reduce computer costs.

Chapter 4

The Montana Input-Output Model

Overview

The Montana Input-Output Model (MIOM) is a 494 sector model based on the 1972 Bureau of Economic Analysis I-O model of the United States. As discussed in ensuing sections, data updating and modification techniques have been applied to the national model to develop a statewide model for Montana that reflects the most current available information. A "state of the art" technique for constructing non-survey regional input-output models was used. This technique was developed by the Regional Science Research Institute and a detailed discussion of the methodology may be found in Stevens et al.[1]

MIOM consists of two computer programs. The first calculates changes in employment, wages, and output which result from exogenous disturbances of final demand on the Montana economy and reports these impacts in a highly disaggregated form. The second program interacts with the first to calculate and report similar results but in a more aggregated and, in many cases, usable format.

The two programs access six separate data files. The largest of these contains the technology matrix which has been modified and updated from the 1972 Bureau of Economic Analysis (BEA) Input-Output Technology Matrix. The remaining data files are used to adjust the national table to describe the specifics of the Montana economy.

As previously illustrated in Chapter 3, the indirect and induced impacts of exogenous changes in final demand can be found by inverting the technology matrix after it has been subtracted from an identity matrix.

This inversion procedure is relatively inexpensive for small matrices. However, the inversion of large matrices (MIOM contains 244,036 elements) is an expensive procedure even for high speed computers. In addition, changes in a single element of the matrix requires that a new inverse be calculated. Therefore, MIOM calculates impacts resulting from exogenous disturbances using the round-by-round iterative approach suggested by Miernyk, (pp. 24-25) and discussed in Chapter 3.

The remainder of this chapter describes the specifics of the data contained in the data files described above. Some of the options available in MIOM for analyzing the impacts of exogenous disturbances will also be discussed.

The Technology Matrix

The technology matrix in MIOM has been developed from the 1972 BEA National Input-Output Table. The 1972 BEA table has been modified and updated to reflect 1977 data. Additional modifications of the BEA table were necessary in order to conform to the availability of state-specific data. In addition, alterations were necessary so that MIOM would include detailed wholesale and retail trade sectors which were not included in the original BEA table.

The result of these modifications is a matrix comprised of 494 sectors with each sector representing a specific industry. Appendix A provides a listing of the sectors in the model. The agricultural sectors (sectors 1-10) have been aggregated according to the classification system used by the Census of Agriculture. The agricultural sectors of the MIOM technology matrix have been further modified to correspond to the Montana agricultural economy.

Aggregations of the BEA table were necessary for the mining sectors (sectors 11-14) and the construction sectors (sectors 15-21). These changes were made so that available wage and employment data could be utilized.

A major difference between the MIOM and BEA technology tables occurs in the treatment of wholesale and retail trade. Because of data limitations, the BEA table included a limited number of highly aggregated trade sectors while the MIOM matrix disaggregates these into 68 separate sectors (sectors 401-468). This additional disaggregation is especially important for a regional I-O model because a large portion of a region's transactions are comprised of trade services.

The wholesale and retail sectors often do not actually "produce" anything in terms of the usual definition of production. Rather, these sectors provide a "service" by making products available to consumers. Value added to commodities in the "production" of these services is measured in terms of "margins". The wholesale margin is merely the difference between the purchase price paid by the wholesaler for a commodity and the sales price paid by retailers. This margin compensates the wholesaler for providing a service. The retail margin is the difference between a retailer's purchase price and sales price paid by consumers. The use of margins as a measure of production for the wholesale and retail sectors is necessary in order to avoid "double-counting" the actual value of goods as they move through an economic system.

The BEA technology matrix consists of 244,036 coefficients. However, only 64,844 of these are non-zero entries. The zero entries in the technology matrix occur because each sector does not directly interact with every other sector of an economy. For example, theoretically one would not expect an interindustry relationship between the feed grains sector

(sector 4) and the manufacturing of women's hosiery (sector 91). In fact, this expectation is correct as the technical coefficient between these two sectors, in MIOM, is zero.

The MIOM technology matrix has 40,054 non-zero elements; fewer non-zero elements than the national model. This was expected because many industries which exist in the national economy are not present in the Montana economy. Therefore, they are represented by zeros in the MIOM technology matrix.[2]

The data file that contains the bulk of the MIOM technology matrix actually consists of 493 columns and 492 rows. Sector 493, administrative and auxiliary offices, is represented by a column of input coefficients. However, it does not have a corresponding set of row coefficients in the actual technology matrix. This is because exogenous disturbances of the economy do not necessarily result in an automatic expansion of administrative services within a given region. These types of services are generally concentrated in very large cities such as New York and Los Angeles. On the other hand, it is possible for a change in a particular sector of the Montana economy to cause a change in local administrative services. For this reason, a set of row coefficients for sector 493 is contained in an auxiliary data file and may be employed in MIOM at the option of the research analyst.

Regional Purchase Coefficients

The concept of Regional Purchase Coefficients (RPC) was introduced in Chapter 2 as a method of regionalizing a national I-O model. An RPC is defined as the proportion of the demand for a good or service which is supplied to a region by itself. While the concept of RPCs may be straightforward, the estimation procedure is not. One method of generating

RPCs is to perform an extensive survey of the flow of goods and services into and out of a state. However, this technique is very costly in terms of both labor and money.

Stevens et al. have developed a non-survey technique for estimating RPCs. Their procedure applies linear regression analysis of known RPCs to develop a model to predict unknown RPCs. Specifically, their process can be separated into three broad steps. First, data concerning actual observed exports from a region are gathered from published sources. Second, a linear regression model is developed that uses variables justified on theoretical grounds (and also readily available) as explanatory variables. Finally, RPCs are estimated from the regression model for those industries which lack export data, but have secondary data available for the model's explanatory variables. This method provides a cost effective technique for regionalizing a highly disaggregated national I-O model (Stevens, et al.).

The MIOM table is regionalized (from the updated 1972 BEA table) using 494 regional purchase coefficients which were specifically estimated for the Montana economy by the Regional Science Research Institute. These RPCs, by definition, must lie between a value of 0 and 1. The RPCs for industries which supply most of a region's needs, i.e. those sectors in which there is little import activity, will be close or equal to 1. For example, in Montana the ready-mix concrete sector, sector 212, has an RPC of 0.962705 -- which indicates that slightly over 96% of the concrete used in Montana is supplied from within the state. Conversely, many manufacturing sectors in Montana have relatively small RPCs, indicative of the fact that Montana is not a major manufacturer of certain commodities -- such as industrial chemicals, sector 160, which has an RPC of 0.247123. Those industries which do not exist in Montana have RPCs equal to zero (e.g. sector 64, soybean oil mills).

The RPC coefficients are maintained in an ancillary data file, apart from the technology matrix. The RPCs are handled in this way for convenience, not necessity. That is, each RPC could be multiplied by each respective element of the technology matrix with the result being a Montana-specific technology matrix. Each element of this matrix would express the amount of input from an industry within the state required to produce a unit of output of another industry within the state. Actually, this is the exact process that the computer program uses in calculating results of exogenous disturbances on the state. However, more flexibility is maintained by storing the RPCs and the technology matrix separately. Logically, RPCs (which measure interregional flows of goods and services) are expected to change more frequently than direct input coefficients (which measure interindustry relationships). Therefore, a change in the status quo flow of goods and services can be more easily considered by altering the 494 RPCs than if the researcher would have to adjust the entire technology matrix (almost one-quarter of a million elements).

The Households Sector

Sector 494 of the MIOM technology matrix comprises the households sector and consists of both a row and a column. The households row is actually calculated during an I-O computer run using state specific data contained in an auxiliary data file.

The households column coefficients are also maintained in an ancillary data file. However, both the household row and column are treated as a part of the technology matrix during an I-O computer run. Thus, the matrix is "closed" with respect to households. This "endogenizing" of the households sector is necessary in order to calculate the induced effects caused by

changes in the level of consumer purchases as a result of an induced change in final demand.

Each element of the households row describes the amount of input that households supply per one dollar of output for each industry. These inputs primarily consist of wages and salaries paid to households as compensation for their labor. In addition, it is assumed that most partnerships and individual proprietorships are locally owned and, therefore, most income which accrues to them will be spent within the state economy. Consequently, the contents of the household row consists of Wages, Salaries, and Proprietors' Income (WSPY).

Corporate profits (which primarily accrue to corporate shareholders) are not included as part of the households row. Although some of these profits undoubtedly accrue to state residents, it is very likely that the bulk of these profits are earned by residents of other states -- especially since Montana has a relatively small population. Thus, it is assumed that most of these profits are "exported" from the state and do not generate additional induced impacts. This assumption may be too restrictive in some cases. However, it is likely that the underestimation of induced effects, due to the exclusion of corporate profits from WSPY, is partially offset by the overestimation of induced effects caused by the inclusion of all proprietors' income, since some of this income undoubtedly accrues to non-residents.

One final note concerning the households row considers the fact that both federal income and social security taxes are paid out of WSPY. It is assumed that these taxes have no indirect or induced repercussions on the state economy. Therefore, they are removed from the WSPY coefficients.

As previously mentioned, the households sector consists of a column of household consumption coefficients (HHC) in addition to the above mentioned row coefficients. A household consumption coefficient for a given sector of the state economy is defined as the expenditure on purchases from that sector by the state's households per dollar of WSPY. Obviously, consumption patterns differ between households. Therefore, the calculation of the HHCs assumes an average household with average expenditure patterns. The household consumption coefficients are adjusted to reflect state and local taxes on incomes, liquor, cigarettes, gasoline, and other items because these types of taxes effectively reduce the consumption of these items per dollar of WSPY.

State and Local Tax Coefficients

State and local tax levels which are changed as a result of exogenous disturbances of an economy tend to be of particular interest to policy-makers even though MIOM assumes that these tax payments do not result in indirect or induced impacts on an economy. This assumption appears to be reasonable since it can not be concluded that increases in tax revenues will automatically generate additional government spending. Rather, a more intuitive approach is to assume that governments collect tax revenues in response to a demand for services. However, if the indirect and induced impacts of changes in tax revenues are of particular interest to a researcher; they can be calculated with MIOM by specifying a new set of direct government purchases which would result from increases in tax revenues.

State and local tax coefficients (SLTC) are estimated for each of the first 493 sectors of the MIOM technology matrix. These coefficients are

calculated in addition to those which were previously estimated for the households sector (sector 494). Recall that the latter included personal state income taxes and taxes on certain consumer items (i.e. gasoline, cigarettes, etc.) which were accounted for with an adjustment to the elements of the household column. Similarly, the effects of federal personal income taxes have been considered by being removed from WSPY.

The remaining state taxes primarily consist of corporate income and franchise taxes while the bulk of local tax revenues consist of property taxes. The estimated coefficients for these taxes express the amount of tax per dollar of output paid by businesses in each sector.

Other Value Added

The concept of "other value added" is a highly aggregated one. The most important components of "other value added" include corporate profits, capital allowances, indirect business taxes, and federal corporate taxes. The "other value added" coefficients have been estimated for each sector as the difference between the total value added coefficients and the sum of the WSPY and STLC coefficients. This identity assures that the value added impacts of an exogenous change in final demand are completely accounted for in the model.

Each estimated coefficient of other value added describes the amount of value which is added by each sector (but not previously accounted for) per dollar of its output. These coefficients are not included as part of the technology matrix indicating that they do not feed back into the economy. Obviously, this is a stringent assumption. However, due to data limitations, this is a necessary restriction. This results in a more conservative estimate of the total impacts of changes in final demand on the economy.

Employment Coefficients

Employment per value added coefficients (EPV) have been estimated for each sector of MIOM. Each EPV describes the amount of employment required per dollar of output for each sector. Therefore, the total change in employment resulting from an exogenous change in final demand is calculated by multiplying the value of the change in output of each sector by its corresponding EPV. The EPVs are stored in an auxiliary data file and are not a direct component of the MIOM technology matrix. They do not, themselves, generate indirect or induced impacts. These effects are already considered via the WSPY coefficients, since changes in household consumption are altered by employment changes.

A cautionary note concerning estimates of changes in agricultural employment due to a change in final demand as estimated by MIOM is appropriate at this time. Over the years, agricultural production has become increasingly capital intensive. Consequently, it is possible for a single individual to produce a relatively large value of output. However, most agricultural production firms possess an excess capacity of labor and can increase output by working additional hours per day. In addition, it is relatively easy for farm operators to substitute capital for labor (i.e. purchase larger and more efficient equipment). Therefore, MIOM is likely to overestimate changes in agricultural employment in terms of absolute numbers. Fortunately, the appropriate interpretation of changes in farm employment prevents misunderstanding. These estimates must be interpreted in terms of additional man-years of labor required by agriculture in response to a change in final demand for agricultural products. It is highly probable that much of these additional man-years of labor will be supplied by existing on-farm labor sources.[3] In other words, farm operators might be expected to increase the amount of hours worked in a given year.

Demand and Output Disturbances

MIOM calculates multipliers and changes in output, employment, and value added which result from exogenous disturbances in final demand. However, there are two different types of exogenous disturbances. For example, assume that the final demand for a particular sector's output is increased by one million dollars. In some cases, a researcher may want to analyze this change in terms of a one million dollar increase in demand for this particular product which would be satisfied by the region's producers. This is considered an "output" disturbance.

On the other hand, the analyst may want to calculate the impact resulting from a one million dollar increase in demand arising from within the region but not necessarily being satisfied from the region. In other words, it is quite possible that an increase in the demand for a product cannot be met by the state's production capabilities. This type of change in final demand is called a "demand" disturbance. Since some of the value of a demand disturbance cannot be satisfied from within the state, the value of the exogenous disturbance is discounted by the corresponding RPC. The RPC measures the amount of the disturbance that is "exported" from the state and, thus, does not generate additional "rounds" of demand.

It is entirely possible for a particular change in final demand to contain both "demand" and "output" components. For example, certain inputs to highway construction can probably be supplied from within the Montana economy while others would have to be "imported" from outside the state. The specification of a disturbance as either a demand or output shock is extremely important in the use of MIOM because this distinction has direct implications for calculating total impacts of a change in final demand.

Notes

1. Other non-survey methods of constructing input-output models have been proposed and used by other researchers. Although all can be criticized on various grounds, the costs associated with survey-based models ensure that non-survey models will continue to be constructed. See Round for a critique of the various non-survey methods.
2. In fact, it can be expected that any sub-region of some larger region will have fewer sectors represented and, hence, fewer non-zero technical coefficients in the technology matrix.
3. Technically, a reason for this problem is that I-O explicitly assumes a fixed input production function. In other words, there is no substitution between inputs. In addition, note that employment is defined in terms of man-years. Obviously, an increase in the output of a non-agricultural sector, like construction, would require employment to expand (in terms of employees) while an expansion in farm output would largely be accomplished with farm operators working additional hours.

Chapter 5

An Economic Description of the Montana Wheat and Barley Industries

Introduction

Agriculture is Montana's largest single industry in terms of cash receipts. Cash receipts derived from the marketing of all agricultural commodities in Montana totalled more than 1.5 billion dollars in 1983.[1] The value of the production of all types of wheat totalled over 500 million dollars and the value of barley production was more than 190 million dollars. These two crops, taken alone, contributed over 46% of Montana's agricultural output.

While these figures help illustrate the importance of wheat and barley production to Montana's farm economy, they do not provide insight concerning their relationship to other Montana industries. An understanding of these relationships is essential in projecting the total economic impacts which accrue to the state economy from changes in final demand for either wheat or barley. As emphasized in the preceding theoretical chapters of this report, input-output analysis is a methodology which allows the evaluation of interindustry relationships and, subsequently, the measurement of the total impacts of an exogenous disturbance. The remainder of this chapter analyzes the structure of the wheat and barley producing sectors and measures the impacts of the production of these two crops on the Montana economy.

Interindustry Relationships

As described in the previous chapter, MIOM consists of 494 sectors. The production and marketing of both wheat and barley involves only a subset

of these sectors. That is, the production of grain crops requires inputs which are produced by some of these sectors, but not all of them.

On a national basis, wheat and barley production requires the direct purchase of inputs from more than 110 different sectors of the national BEA input-output model. Table 5.1 shows the amount of purchases required per dollar of both wheat and barley production for the national and state economies. For ease of illustration the results have been aggregated to 10 general categories.[2] The first column of Table 5.1 shows that, on a national basis, wheat producers purchase slightly more than 10 cents of their inputs from other agricultural producers for every one dollar of wheat output.[3] Approximately 27 and 23 cents of inputs per dollar of output are purchased from the Manufacturing and Finance, insurance, and real estate sectors, respectively. The remaining coefficients of the first column, while small, may be interpreted in a completely analogous fashion.

On a regional (in this case a state) level, some of these interindustry purchases are made from suppliers outside the Montana economy. This "openness" of regional economies results in leakages from the state -- inputs are purchased from firms that are located outside of Montana's borders. These leakages are evident in two different forms. First, while national wheat production requires inputs from 110 different sectors, the production of Montana wheat involves purchases from only 68 Montana industries. The purchases from the remaining 42 sectors are still made, but none of these 42 sectors exist in Montana. Therefore, the purchase from these sectors require purchases from outside the state and do not produce additional income in Montana.

Second, even though 68 of the sectors supplying inputs for wheat production exist in Montana, most of them do not supply 100 percent of the

Table 5.1. Comparative Analysis of the Structure of U.S. and Montana Wheat and Barley Sectors. Column Coefficients -- Purchases By Wheat and Barley Sectors From One-Digit Industries.

	Cost of Inputs by Sector Per Dollar of Output			
	Wheat		Barley	
One-Digit Sectors	U.S.	Montana	U.S.	Montana
	(------------------$------------------)			
Agriculture	.103131	.091802	.092863	.079098
Agricultural services, forestry, & fisheries	.032094	.013329	.030402	.012623
Mining	.009462	.009115	.014041	.013526
Construction	.015115	.015115	.012929	.012929
Manufacturing	.265714	.091674	.346731	.102968
Transportation & public utilities	.031308	.019105	.042983	.026922
Wholesale trade	.039405	.035091	.055696	.049599
Retail trade	.008500	.000683	.000754	.000607
Finance, insurance, & real estate	.228905	.144925	.147045	.093012
Services	.026017	.013667	.030557	.015351

state's needs. Therefore, only a portion of the inputs utilized from these sectors are satisfied by local firms. The second column of Table 5.1 helps to illustrate, from an aggregate perspective, this second form of purchasing power leakages. These coefficients describe the purchases of inputs from <u>within</u> the Montana economy needed to produce one dollar of Montana wheat. Notice that each of these state coefficients are smaller than their national counterparts. The one exception is the Construction sector where the state and national coefficients are of equal sizes. This occurs because Montana supplies all of the light construction and repair needs of the Montana wheat and barley sectors. However, the difference between the state and national coefficients for the other nine categories shows that Montana imports goods and services in each of those areas. The largest difference between the national and Montana coefficients occurs in the Manufacturing sector. While national wheat production requires over 26 cents of inputs per dollar of output from this sector, only nine cents of this total is purchased from Montana manufacturing industries. This is to be expected given the non-industrial nature of the state economy. Another area of major difference occurs in the Finance sector where Montana producers purchase about nine cents of inputs from Montana firms per dollar of output. On a national basis, over 22 cents of these inputs are required per dollar of output.

Table 5.1 also presents the sectoral input requirements per dollar of barley production on both a national and state basis. The barley production coefficients can be interpreted in the exact manner as those for wheat production. It is interesting to note that, as expected, the input requirements per dollar of barley production are quite similar to wheat production.

The coefficients in Table 5.1 help illustrate the fundamental basis of input-output analysis -- that a change in the final demand and subsequent output of any sector causes additional changes in the output of other related sectors. For example, if the final demand for wheat production increased by 10 million dollars (the direct effect), then the production of inputs necessary to produce wheat would also increase. Multiplying each element of the first column of Table 5.1 by the direct effect yields the additional inputs directly used to produce an additional 10 million dollars of wheat. Some of these inputs would be supplied from outside of the Montana economy. Therefore, multiplying the direct effect by the coefficients of the second column yields the additional inputs directly purchased from Montana industries in order to produce an additional 10 million dollars of wheat. These primary impacts upon industries producing inputs used in wheat production are termed indirect effects.

However, use of the column coefficients only measures the initial or primary impact of the expanded output in wheat production. Additional indirect effects occur as these supplying industries will require additional inputs from other industries. These indirect effects will ripple throughout the economy. Each sector's increase in demand also results in the generation of additional labor demands which ultimately increases the incomes of households. These increases in incomes launch additional spending by consumers which puts further demands on the outputs of businesses. This additional increase in output is the induced effect. The use of multipliers provides a less complex method to measure total impacts of an exogeneous disturbance on an economy. Multipliers will be discussed, in detail, in the following section.

Multipliers

The concept of impact multipliers is the most often used and misused result of input-output analysis. It is a measure of total changes in economic activity which result from exogenous disturbances, since the total effects (direct, indirect, and induced) of exogenous disturbances are included. Properly used, impact multipliers generated from I-O tables are appropriate tools for analyzing impacts which result from economic or policy changes.

On the other hand, it is also a measure that is very often abused. There appear to be several reasons for this. One problem originates from the observation that there is no such thing as "a single" multiplier. That is, there are many different categories and types of multipliers. MIOM calculates four multipliers -- output, employment, income, and value added -- however, there are many others (e.g., income psuedo-, employment psuedo-, value added psuedo-multipliers). This issue is further complicated by the definition of several different "types" of each of these multipliers. For example, Type I, Type II, or Type III income multipliers can be calculated -- with each defined differently and each serving its own specific purpose.[4] MIOM calculates Type II multipliers for each of the four previously mentioned categories. Finally, added confusion results from the method in which each multiplier is calculated and, ultimately, interpreted. A Type II multiplier is the ratio of the direct, indirect, and induced impacts to the direct impacts resulting from an exogenous disturbance of final demand. Therefore, the specification of the direct effects plays an important role in determining the magnitude of the multiplier. MIOM specifies the direct effects as the actual exogenous disturbance to an output sector. In contrast, some researchers specify the direct effects as

the actual disturbance plus the associated "first-round" effects of additional purchases of inputs from other sectors necessary to meet the original change in final demand. The specification of direct effects by MIOM appears to be sensible since an analyst is more often asked to ascertain the "impact of a 10 million dollar change in the output of the Montana wheat industry" than to calculate the "impact of a 10 million dollar change in the output of the Montana wheat industry and all of the increases in the outputs of related industries necessary to meet the increased production." However, comparisons of multipliers between any two I-O models and the use of multipliers from any single model should be done with considerable caution. For example, defining the direct effect as including the purchases of inputs in the "first round" of activity will result in somewhat more conservative multiplier values than the definition of direct effects in MIOM. For this reason the multipliers reported below may be higher than those reported in some studies of surrounding states.

The Type II multipliers as calculated by MIOM for the Montana wheat and barley sectors are presented in Table 5.2. The output multiplier for wheat is 1.84. The correct interpretation is that a one dollar increase in wheat production will generate $1.84 of total output within the state <u>including the original $1.00 change</u>. A more precise interpretation would be that each one dollar increase in wheat output will generate an <u>additional</u> 84 cent change in the output of the economy. The barley output multiplier is 1.83, nearly the same as the wheat sector multiplier.

Table 5.2. The Multipliers of the Montana Wheat and Barley Sectors

Multiplier Type	Wheat Sector	Barley Sector
Output Multiplier[a]	1.84	1.83
Income Multiplier[b]	2.28	2.18
Income Psuedo-Multiplier[c]	.31	.34
Value Added Multiplier[d]	2.72	2.76
Employment Multiplier[e]	1.80	1.85
Employment Psuedo-Multiplier[f]	.00003	.00003

[a] The output multiplier is the ratio of the direct, indirect, and induced output effects to the direct output effect of an exogenous disturbance on the state economy. The wheat (barley) output multiplier indicates that an additional 84 cents (83 for barley) of output is generated (foregone) in the economy for every $1 increase (decrease) in wheat (barley) output.

[b] The income multiplier is the ratio of the direct, indirect, and induced income effects to the direct income effect of an exogenous disturbance on the state economy. The wheat (barley) income multiplier indicates that an additional $1.28 ($1.18 for barley) of income is generated (foregone) in the economy for every $1 increase (decrease) in income derived from wheat (barley) production.

[c] The income psuedo-multiplier is the ratio of the direct, indirect, and induced income effects to the direct output effect of an exogenous disturbance on the state economy. The wheat (barley) income psuedo-multiplier indicates that 31 cents (34 cents for barley) of income is generated (foregone) in the economy for every $1 increase (decrease) in wheat (barley) output.

[d] The value added multiplier is the ratio of the direct, indirect, and induced value added effects to the direct value added effect of an exogenous disturbance on the state economy. The wheat (barley) value added multiplier indicates that an additional $1.72 ($1.76 for barley) of value added is generated (foregone) in the economy for every $1 increase (decrease) of value added in wheat (barley) production.

[e] The employment multiplier is the ratio of the direct, indirect, and induced employment effects to the direct employment effect of an exogenous disturbance on the state economy. The wheat (barley) employment multiplier indicates that an additional .80 (.85 for barley) FTE positions are generated (foregone) in the economy for every 1 FTE position generated (foregone) in wheat (barley) production.

[f] The employment psuedo-multiplier is the ratio of the direct, indirect, and induced employment effects to the direct output effect of an exogenous disturbance on the state economy. The wheat (barley) employment psuedo-multiplier indicates that 3 FTE positions (also 3 for barley) are generated (foregone) in the economy for every $100,000 increase (decrease) in wheat (barley) output.

The Type II income multiplier was defined in preceding chapters as the ratio of the direct, indirect, and induced income change to the direct income change which results from a change in final demand. The income multiplier for the wheat sector is 2.28, which indicates that for every $1.00 increase in income (most of which would accrue to proprietors and farm laborers) as a result of a change in final demand for wheat, an additional $1.28 of income will be generated in the state economy. The income multiplier for the barley sector is 2.18 and is interpreted in an analogous fashion.

A cautionary note concerning income multipliers is appropriate at this time. The income multiplier measures the total income effects as a ratio to the direct income effects -- not the direct output effects. That is, the barley income multiplier of 2.18 indicates that $1.18 of additional income is generated within the state for every $1.00 increase in income that accrues to the barley sector as a result of a change in final demand. However, a frequent mistake occurs when the income multiplier is interpreted in relation to output. For example, to say that $1.18 of additional income is generated as a result of a $1.00 increase in the output of the barley sector is incorrect. The relationship between total income and direct output changes is measured by an income psuedo-multiplier (Johnson and Kulshreshtha). The income psuedo-multiplier is not directly calculated by MIOM. However, its calculation is not complicated and is also presented for each sector in Table 5.2.

The income psuedo-multiplier for wheat production is .31 which indicates that 31 cents of income is generated within the economy for every $1.00 increase in the output of wheat. This 31 cents includes the income which accrues to wheat producers as well as other proprietors and households

in the economy. The income psuedo-multiplier for barley production is .34. A comparison of the income psuedo-multiplier to the income multiplier for each sector quickly emphasizes the gross errors that can result from the substitution of one class of multiplier for another.

Value added is defined as the difference between the value of inputs employed in wheat and barley production and the value of the output of this process. Changes in the final demand for either wheat or barley directly effects the total value which is added to inputs in this production process. The value added multiplier measures the total value added impacts on the state economy as a ratio to the direct value added as a result of a change in final demand.

The value added multipliers for the wheat and barley sectors, in Table 5.2, are 2.72 and 2.76, respectively. The value added multiplier for wheat production indicates that an additional $1.72 of value is added by the state economy for every $1.00 of value which is added by wheat production. A similar interpretation holds for the value added multiplier for barley.

The employment multipliers of the wheat and barley sectors are also presented in Table 5.2. It is important to note that employment is considered in terms of full-time equivalents (FTE). While it is impossible to hire a fraction of an employee, it is possible to hire a fraction of an FTE by employing an individual for only a portion of the year. In addition, increases or decreases in employment are not always represented by hiring or firing an employee. In many cases, employees work overtime during periods of high demand or work a reduced number of hours during slack times. This is especially true in agricultural production where available labor resources either work longer or shorter days depending upon the season.

The employment multiplier for wheat production is 1.80 which indicates that an additional .80 FTE positions are generated in the economy for every 1 FTE employee added to wheat production. The employment psuedo-multiplier measures the relationship between employment and output. The employment psuedo-multiplier for wheat production is .00003 which shows that 3 FTE positions are generated in the state for every $100,000 increase in the production of wheat.

The employment multipliers for the barley sector are almost identical to those for the wheat sector. The employment multiplier is 1.85 and the employment psuedo-multiplier is .00003.

The Impact of a Change in Final Demand for Wheat

One method of illustrating the interrelationships between industries is to trace through the effects of an exogenous disturbance from one sector through the other sectors in the economy. This allows an analyst to view the impacts on all of the sectors which are generated by the disturbance of a single sector.

For purposes of illustration, the total impacts resulting from a 10% increase in wheat production over 1983 levels will be simulated using the 1983 Montana average price of all wheat. This results in an approximate 50 million dollar increase in output. This figure is merely used for illustration and not prediction. It is assumed that this increase is the result of a change in final demand -- for Montana, we could assume a change in export demand. In addition, one could easily consider a 50 million dollar decrease in production and obtain results of the same magnitude except in the negative direction.

The total impact of this increase in final demand is presented in Table 5.3. The results are reported on a highly aggregated basis with the exception of Agriculture -- in which case they are also reported on a more disaggregated level. The associated disaggregated results are presented in Appendix B. The total impact of the 50 million dollar increase in final demand for wheat on the Agricultural sector is $55,043,000, including the original $50,000,000 increase. The total impact is larger than the original disturbance because the wheat sector would demand additional inputs from other agricultural sectors to produce the increase in production. The 50 million dollar increase in final demand is, as previously mentioned, arbitrary. If one would want to analyze the impact of a 100 million dollar increase (or decrease) of final demand for wheat, each figure in Table 5.3 would simply be twice as large. This phenomenon occurs because of the limiting, though necessary, assumption of linear production functions.

The value added by agriculture, as a result of the increase in final demand, is $13,225,000. An additional $7,203,000 of agricultural wages, salaries, and proprietors income would also be generated by this disturbance. Over 908 FTE jobs in agriculture would be created. It is assumed that some (or perhaps most) of these FTE positions in agriculture would be filled by additional utilization of currently employed agricultural labor and farm proprietors.

The original exogenous disturbance generates impacts on other industries in addition to agriculture. For example, the Finance, insurance, and real estate sector would increase its output by $11,437,000. This sizeable increase is as expected since increases in agricultural production places increased demands on credit agencies and land values. The Manufacturing sector also displays a substantial increase in output of

Table 5.3. The Impact of a 50 Million Dollar Increase in the Final Demand for Wheat.

	Output ($1,000)	Value Added ($1,000)	Wages ($1,000)	Employment (FTE)
Agriculture	55,043	13,225	7,203	908.8
Dairy, poultry, & eggs	235	29	24	7.2
Meat animals & misc. livestock	2,372	193	138	45.2
Food grains	52,010	12,899	6,969	848.8
Feed grains	380	86	59	6.2
Sugar crops	2	1	0	0
Misc. crops	24	5	4	.7
Forest products	1	0	0	0
Greenhouse & nursery products	20	13	8	.8
Agri services, forestry, fisheries	773	357	346	50.9
Mining	2,433	1,561	423	15.2
Construction	1,359	1,054	1,010	42.6
Manufacturing	8,720	1,470	464	24.4
Transportation & public utilities	2,902	1,467	736	33.3
Wholesale trade	2,546	1,719	1,079	61.7
Retail trade	2,632	1,724	1,197	110.3
Finance, insurance, real estate	11,437	8,946	1,450	100.2
Services	3,639	2,095	1,328	115.8
Government enterprises	279	116	52	3.1
TOTAL	91,764	33,734	15,288	1,466.3

Note: Totals may not add due to rounding.

$8,720,000. This is also as expected since increased demands would be placed on various outputs of manufacturing such as petroleum products, fertilizers, machinery, and chemicals. Other sectors of the economy are also influenced by the change in final demand. The relative magnitudes for each sector can be interpreted from Table 5.3.

The total impacts of the 50 million dollar increase in final demand on the output of the state economy is $91,764,000 which includes the original disturbance. In other words, the initial 50 million dollar increase in agricultural output generated an additional $41,764,000 increase in the output of the state economy. The total value added amounted to $33,734,000 and total wages were increased by $15,288,000. Slightly more than 1,466 FTE positions were added by the increase in final demand.

Policy makers are often interested in the changes in tax revenues that occur as a result of changes in economic activity. MIOM calculates these tax impacts as a result of an exogenous disturbance.[5] Obviously, these estimates are dependent upon the assumption that tax policies do not directly react to small changes in economic activity. Therefore, total state tax revenues are expected to increase by $1,255,072 as a result of the change in final demand while total local taxes (the summation of those revenues that accrue to all city and county governments) are expected to increase by $1,635,476.

The Impact of a Change in Final Demand for Barley

A 20 million dollar increase in barley production would represent about a 10% increase in production over 1983 levels using the 1983 Montana average price for all barley. Once again, this figure is arbitrary and merely used

for purposes of illustration. Linear extrapolation will yield the effects of larger or smaller changes in output.

Table 5.4 shows that a 20 million dollar increase in final demand for barley results in an increase in the state economy's output of $36,626,000 (for the disaggregated results, see Appendix C). This latter figure includes the initial disturbance. A total of $12,493,000 of value is added to the state economy while $6,743,000 of income (wages) is generated. Slightly over 604 FTE positions would be created.

The individual sectors displaying the largest impact, with the exception of Agriculture, are the Manufacturing and Finance, insurance, and real estate sectors. Both of these sectors supply a substantial portion of the inputs used in barley production (see Table 5.1).

The increase in barley production and subsequent increases in the outputs of other industries results in increases in tax revenues. State tax revenues would experience a $435,502 increase while local governments would receive an additional $661,510.

Summary Remarks

The Montana wheat and barley producing sectors purchase inputs from over 110 different sectors of the national economy. However, Table 5.1 illustrates that many of these sectors are nonexistent or produce only a portion of the needed input requirements within the state. As a result, a portion of the purchasing power generated from changes in final demand for Montana wheat and barley is a leakage from the state economy. This is not unusual, in that most state economies are fairly "open". A notable exception might be California, which has a large amount of both manufacturing and agricultural industries.

Table 5.4. The Impact of a 20 Million Dollar Increase in the Final Demand for Barley.

	Output ($1,000)	Value Added ($1,000)	Wages ($1,000)	Employment (FTE)
Agriculture	22,080	4,804	3,303	369.3
Dairy, poultry, & eggs	401	49	42	12.3
Meat animals & misc. livestock	1,048	85	61	19.9
Food grains	9	2	1	.2
Feed grains	20,594	4,658	3,192	336.1
Sugar crops	1	0	0	0
Misc. crops	19	4	4	.5
Forest products	0	0	0	0
Greenhouse & nursery products	8	5	3	.3
Agri services, forestry, fisheries	298	138	133	19.6
Mining	1,096	701	199	7.2
Construction	472	366	350	14.8
Manufacturing	3,847	677	224	11.9
Transportation & public utilities	1,397	697	365	16.8
Wholesale trade	1,318	887	559	32.2
Retail trade	1,157	759	527	48.5
Finance, insurance, real estate	3,190	2,476	472	31.2
Services	1,598	921	585	51.0
Government enterprises	174	68	25	1.6
TOTAL	36,626	12,493	6,743	604.2

Note: Totals may not add due to rounding.

The output multipliers for both the wheat and barley sectors are approximately 1.8 -- which indicates that an additional 80 cents of output is generated within the Montana economy for every one dollar increase in the output of wheat or barley. The multiplier can be interpreted in a similar fashion for an output reduction. The income multiplier for wheat is 2.28 indicating that an additional $1.28 is generated within the Montana economy for every one dollar of income that is generated in the wheat sector due to some change in final demand. The income multiplier for barley is 2.18 and can be interpreted in the same manner as the income multiplier for wheat production. All of these multipliers are quite small in relation to some other industries. This is the usual case for industries whose output lacks an associated high degree of local processing.

Tables 5.3 and 5.4 present the results of a 10% change in the final demand for wheat and barley, respectively. The results show that the wheat and barley sectors have substantial impacts upon much of the Montana economy. In addition, both state and local tax revenues are influenced by changes in output levels.

Notes

1. This and the following dollar figures concerning 1983 production levels are preliminary estimates made by the Montana Crop and Livestock Reporting Service.
2. The purchases by sector, disaggregated to the most specific level in MIOM, are shown in Appendix A. For a detailed description of the structure of the intersectoral relationships between the wheat/barley sectors and the rest of the economy readers should consult this appendix table.
3. Here and elsewhere in Chapters 5 and 6 the discussion in the text rounds off numbers as appropriate. Two considerations caused this strategy: (1) ease of presentation in the text, (2) concerns regarding accuracy of reported coefficients. With regards to the second point it should be noted that error in empirical analysis, and particularly in I-O analysis, can arise from various sources. Therefore, readers should not make major distinctions between coefficients when they differ by small amounts. For a discussion of accuracy in I-O models readers are referred to Jenson.
4. For a discussion of the differences between these multipliers, see Chapter 2.
5. As noted in Chapter 4, it is assumed that these tax revenue changes do not generate additional indirect or induced effects.

Chapter 6

Simulated Impacts of Selected Exogenous Disturbances on the Montana Wheat and Barley Sectors

Overview

Exogenous disturbances of the wheat and barley sectors may originate from a variety of sources. For example, a portion of the preceding chapter discussed the impacts on the economy of changes in export demand for Montana wheat and barley. Government farm programs can also cause an exogenous shock to a regional or national economy. Furthermore, the introduction or expansion of grain-related industrial facilities would result in a change in the demand for wheat and/or barley. This chapter will utilize MIOM to simulate and analyze selected exogenous shocks which either have occurred or might occur at some time in the future.

The economic impact of the 1983 farm programs on the state economy will be analyzed under two scenarios: (1) the farm program as specifically administered in Montana in 1983, and (2) an alternative farm program assuming fallow land could not be used to meet requirements for establishing setaside acreage. A more detailed discussion of the differences between these two scenarios is included below. While these programs were directed at agricultural producers, they also indirectly impact other sectors of the economy due to interindustry relationships described in earlier chapters. Therefore, I-O analysis provides a means for measuring the total impact of these farm programs on the Montana economy. It is hoped that this analysis will aid wheat and barley producers in formulating suggestions, through various farm organizations, on the development of farm policy.

In addition, the potential impacts on the barley and wheat sectors of the possible establishment of a major beef packing facility within the state will be simulated. The effects on barley production resulting from possible increases in the demand for feed grains caused by increased cattle feeding are considered. This particular simulation can not be interpreted as a feasibility study for or against the establishment of such a plant. MIOM is only appropriate for identifying the potential statewide economic impacts of such a facility on barley and wheat production. Many other considerations must be analyzed before determining the feasibility or potential profitability of such a venture.

It should be noted that all calculations of economic impacts presented below are simulated; that is, they were generated with exogenous disturbances to the I-O model. While indicative of actual impacts on the Montana economy, this type of normative empirical analysis should not be explicitly interpreted as the actual outcome.

Impact of the 1983 Wheat and Barley Diversion Programs

The federal government continued the 15% acreage reduction and 5% paid diversion programs for both wheat and barley production in 1983. In non-continuous cropping regions such as Montana, a unique situation exists for evaluating both the wheat and barley diversion programs. In general, farmers were compensated for idling up to 20% of their wheat or barley base from production. A requirement of program participation is that the idled land must be maintained in some type of conserving use practice. Therefore, it appears that the impacts of the diversion programs should consist of a combination of foregone output (either wheat or barley) and foregone inputs caused by program participation. Indeed, in areas characterized by

continuous cropping practices, this would be the case. However, Montana wheat and barley production is typified by crop-fallow practice so that, in any given year, a producer generally fallows 50% of his cropland and plants the remainder. The 1983 farm program is worded in such a way so as to allow producers to use a portion of fallow acreage to fulfill the program condition that 20% of the acreage base be idled. Therefore, under the conditions of the program, a wheat (barley) producer could plant 80% of his usual wheat (barley) crop, place 20% of his fallow acreage into a conserving use practice, and plant the remaining 20% of his usual cropped acreage to a non-wheat (or non-barley) crop. Note, at this point, that any reduction in acreage is illusionary -- the primary result is a transfer of acreage to an alternative crop.

To further illustrate this point, assume that a wheat producer has 2,000 acres of cropland and that, normally, one-half (1,000 acres) of the acreage is fallowed. Assume further that 20% of the wheat base (200 acres) is idled in compliance with the farm program. The wording of the farm program permits this hypothetical farmer to place 200 acres of his fallow into a conserving use practice and, though it was not explicitly stated, plant the remaining 200 acres of his wheat base to a non-wheat crop (e.g. barley or safflower). From the perspective of the net impact on the state economy, the result is that the normal setaside program had little effect. The only major effects were the substitution of one crop for another. Modest changes in farm proprietors' incomes may have occurred. However, since participation in the program was voluntary and participants received compensation, it seems reasonable to assume that producers would not enroll in the program unless they perceived benefits from participation.

Wheat and barley production require similar types and quantities of inputs (see Chapter 5). Therefore, it appears that the impact on the state economy of the diversion program was likely minimal.

Simulated Impact of the 1983 PIK Program

In January 1983, the Reagan Administration announced the payment-in-kind (PIK) program for major crops (wheat, corn, sorghum, rice, upland cotton). This program was initiated to encourage crop acreage reduction, bolster net farm income, and reduce excess grain stocks. The PIK program was implemented as a supplement to the previously enacted acreage diversion programs. However, the PIK program was not independent of the diversion programs since participation in the latter was a requirement for enrollment in PIK.

The effects of PIK on the economy were different than those for the diversion program for two reasons. First, the wording of the PIK legislation required that the actual land enrolled in PIK had to be maintained in a conserving use practice. An alternative grain crop could not be planted and harvested for grain on that land, as was possible in the diversion program. The second reason for differential effects involves the method of remuneration for participating producers. Whereas those in the diversion program received monetary payment for participation, PIK farmers received grain. In general, both money and grain reflect purchasing power and therefore, can be considered as transfer payments. However, those receiving grain had to market the grain and, hence, purchase marketing inputs (i.e. transportation, storage facilities, etc.) before they received "money" from the program. Therefore, the net effect of PIK on the economy is the combination of two factors: (1) the effects of decreased grain

production on the purchase of production inputs, and (2) the partially offsetting effects of purchasing marketing inputs for the PIK grain received by producers.[1]

Producers received a percentage of the grain which would have been produced on the acres enrolled in PIK (hereafter called the PIK exchange rate). Montana Agricultural Stabilization and Conservation Service officials indicate that the net PIK exchange rate was approximately 85%. This is the net result of grain exchanged on the 10-30 PIK program at a 95% rate in conjunction with whole base bids. Therefore, a total of 15% of the expected 1983 wheat crop of PIK enrolled acreage was neither produced nor marketed. On the other hand, 85% of expected production on PIK acreage was marketed but not produced in 1983.

The total value of wheat production foregone was estimated by multiplying the net PIK-induced production decrease (the number of acres enrolled in PIK by the average yield per acre) by the average price per bushel for all wheat marketed.[2] This figure totals $136,869,000. Fifteen percent of this was programmed into MIOM as a negative wheat output shock to reflect the PIK exchange rate, thus affecting both production and marketing inputs. The remaining 85% of the total value foregone represents wheat which was marketed, but not produced. Therefore, only production inputs would be adversely affected.

The MIOM technology matrix describes the amount of each input required to produce one dollar of wheat output (see Table 5.1). Multiplying these coefficients by 85% of $136,869,000 allows calculation of the amount of all inputs required to produce the quantity of wheat paid to farmers.[3] However, the total input requirements must be adjusted for two reasons. First, the marketing input components should not be reduced by this volume of grain.

Once again, these marketing inputs would be required in order to transform wheat received from the PIK program into dollars. Second, the production input components need a positive adjustment since farmers were required to purchase a portion of these inputs when maintaining idled PIK land in conserving use practices. It is assumed that one-third of the normal production inputs employed in wheat production were necessary to comply with the PIK requirements (Johnson). Therefore, the value of each of the production inputs foregone from the initial calculation above was multiplied by two-thirds to represent the net value of production inputs foregone (in addition to the previously mentioned inputs associated with 15% of the value of PIK wheat) due to PIK.[4]

Table 6.1 presents the total simulated impact of the PIK program on the Montana economy in terms of net changes in output, wages, and employment. All of the figures are negative as a result of the production decreases caused by PIK. A more disaggregated presentation of these impacts is contained in Appendix D. The figures for the Agriculture sector are the indirect and induced effects of the PIK program (the direct impacts are netted out). For example, this simulation of the program initially caused a 25.3 million dollar decrease in the output of wheat. This is the direct effect of the program. This direct effect caused an additional loss of output from agriculture of 6.5 million dollars in our simulation -- the indirect and induced impacts. Wages foregone totalled $400,000 and 124 FTE positions were lost. There was a direct loss of 412 man-years of labor in agriculture as a result of the simulated 25.3 million dollar output shock. The direct wages lost in agriculture were assumed to be zero because, as previously mentioned, producers received a payment to enter the voluntary program. This assumption appears reasonable since this was not a riskless

Table 6.1. Simulated Impact of the Payment-In-Kind Program For Wheat in Montana, 1983[a]

Sector	Output ($ million)	Wages ($ million)	Employment (No.)
Agriculture[b]	6.5	0.4	124
Agricultural services, forestry & fisheries	1.5	0.7	99
Mining	4.3	0.8	27
Construction	2.0	1.5	64
Manufacturing	14.5	0.7	34
Transportation & public utilities	3.2	0.7	34
Wholesale	4.5	2.0	117
Retail Trade	1.9	0.8	79
Finance, insurance, & real estate	3.8	1.0	59
Services	3.8	1.4	110
Government	0.4	0.1	4
Total - Net of Direct Impact[c]	46.5	10.0	749
Direct Impact - Agriculture	25.3	0.0	412
Total	71.8	10.0	1,161

a. All figures shown are negative numbers, resulting from production decreases caused by PIK.

b. The figures for agriculture reflect changes as a result of netting out the direct change in wheat output.

c. Totals may not add due to rounding.

decision -- some producers undoubtedly suffered a reduction of net farm income while others realized increases.

The value of manufacturing output decreases by 14.5 million dollars as a result of simulation of PIK. This sector displays the largest impact, in terms of output, because it supplies a substantial share of the production inputs necessary to produce wheat (e.g. chemicals, petroleum, fertilizers, machinery). Manufacturing suffered a \$700,000 dollar decrease in wages. However, Wholesale trade displays the largest wage impact -- 2 million dollars. This is because wholesale trade is more labor intensive than most manufacturing enterprises. Agriculture lost an additional 124 FTE positions (in addition to the initial 412) as a result of this simulation of PIK while the Wholesale and Service sectors lost 117 and 110 positions, respectively.

Overall, an estimated additional 46.5 million dollars of output was foregone due to the initial 25.3 million dollars of wheat production foregone as a result of the simulation of the PIK program. Wages were reduced by 10 million dollars and employment fell by 749 FTE positions (in addition to the initial direct loss of 412 agricultural positions).

The table does not show the simulated effect of the PIK program on state and local tax revenues. Total state taxes, estimated by MIOM, fell by \$837,282 while total local taxes fell by \$1,281,171.

Table 6.2 expresses the estimates of the total reduction in output and wages presented in Table 6.1 in dollars per bushel of enrolled production and employment in man-years per million bushels of enrolled production. These numbers may be interpreted as the indirect and induced cost of the PIK program, by sector, expressed in terms of the lost output, wages, and employment for each bushel of reduced wheat production. Each bushel of PIK wheat cost an estimated \$1.19 in reduced output net of the initial 65 cent

Table 6.2. Simulated Per Bushel Costs of the Payment-In-Kind Program For Wheat in Montana, 1983[a].

Sector	Output ($/bu)	Wages ($/bu)	Employment (No./mil. bu.)
Agriculture[b]	0.17	0.01	3.16
Agricultural services, forestry & fisheries	0.04	0.02	2.52
Mining	0.11	0.02	0.69
Construction	0.05	0.04	1.63
Manufacturing	0.37	0.02	0.87
Transportation & public utilities	0.08	0.02	0.87
Wholesale	0.11	0.05	2.98
Retail Trade	0.05	0.02	2.01
Finance, insurance, & real estate	0.10	0.03	1.50
Services	0.10	0.04	2.80
Government	0.01	0.00	0.10
Total - Net of Direct Impact[c]	1.19	0.25	19.10
Direct Impact - Agriculture	0.65	0.00	10.51
Total	1.83	0.25	29.60

a. The output, wage, and employment reductions from Table 6.1 are divided by 39,217,600 bu.

b., c. See notes on Table 6.1.

direct effect. Once again, Manufacturing shows the largest per bushel output cost of 37 cents. This is followed by Agriculture at 17 cents and Wholesale trade at 11 cents. The total per bushel cost of wages is 25 cents. Wholesale trade suffered the largest wage cost per bushel at 5 cents. Finally, total employment was reduced by 19.1 FTE per million bushels (net of the direct effect) in the simulation. Agriculture displayed the highest loss at 3.16 and was followed closely by Wholesale trade at 2.98 and the Service sector at 2.80.

Table 6.3 transforms the simulated costs of the PIK program on the Montana economy to a per acre basis. The same relative sector costs are illustrated as in Table 6.2. However, the output and wage losses are calculated in dollars per acre enrolled and the employment foregone is in FTE positions per one million acres enrolled. The overall loss of output, net of Agriculture, is estimated to be $36.40 per acre, while wages fell by $7.83 per acre. Employment foregone totalled 586.33 FTE positions net of the direct effect.

Table 6.4 presents the estimated number of non-agricultural FTE positions foregone as the result of the PIK program. The largest loss occurs in the Clerical workers category with 199.9 FTE positions foregone. This is followed by Managers and administrators and General laborers with 80 and 78.7 positions respectively.

Simulated Differential Effects of the PIK and Diversion Programs If Setaside Acres Are Actually Idled

The simulated effects of both the PIK and diversion programs as determined by actual 1983 legislation have been discussed above. However, different results would have occurred if the acreage reduction restrictions

Table 6.3. Simulated Per Acre Costs of the Payment-In-Kind Program For Wheat in Montana, 1983[a].

Sector	Output ($/acre)	Wages ($/acre)	Employment (No./mil. acres)
Agriculture[b]	5.09	0.31	97.07
Agricultural services, forestry & fisheries	1.17	0.55	77.50
Mining	3.37	0.63	21.14
Construction	1.57	1.17	50.10
Manufacturing	11.35	0.55	26.62
Transportation & public utilities	2.50	0.55	26.62
Wholesale	3.52	1.57	91.59
Retail Trade	1.49	0.63	61.84
Finance, insurance, & real estate	2.97	0.78	46.19
Services	2.97	1.10	86.11
Government	0.31	0.08	3.13
Total - Net of Direct Impact[c]	36.40	7.83	586.33
Direct Impact - Agriculture	19.81	0.00	322.52
Total	56.21	7.83	908.85

a. The output, wage, and employment reductions from Table 6.1 are divided by 1,277,446 acres.

b., c. See notes on Table 6.1.

Table 6.4. Simulated Employment Impacts of the Payment-In-Kind Program For Wheat in Montana, 1983.

Employment Category	Employees (no.)
Engineers	6.6
Computer specialists	3.0
Health professionals	11.2
Engineering and science technicians	6.5
Teachers (ex. college)	2.6
Writers & artists	9.1
Religious, social & teaching professionals	8.2
Professional, technical, n.e.c.	24.7
Managers & administrators	80.0
Sales workers	48.5
Clerical workers	119.9
Construction craftsmen	43.7
Craftsmen (ex. const.)	50.2
Operators (ex. transportation)	44.0
Transportation equipment operators	29.0
Laborers	78.7
Personal service workers	59.0

Note: All figures shown are negative numbers, resulting from decreases caused by PIK.

of the diversion program are specified the same way as for the PIK program. That is, if the actual acres idled were required to be acres which a producer had initially intended to plant, rather than allowing fallow land to qualify as the setaside acres. This stipulation would result in actual grain reductions rather than merely a substitution between grain crops. In addition, differential effects on the economy, between programs, can be expected because marketing inputs would be required for the PIK program while they would not be necessary for the setaside program. The following discussion describes the effects of these two programs <u>if</u> the 1983 diversion program had been written to prevent the use of normal fallow as setaside acreage. Therefore, this hypothetical case should help illustrate the possible economic impacts on the Montana economy of a change in program compliance to force idling of land intended for seeding.

The estimated effects of the PIK program are identical to those previously discussed.[5] However, while the actual 1983 diversion program had little impact on the Montana economy, substantial production decreases would occur if fallowed land could not be used for the setaside acreage. Both production and marketing inputs would be adversely affected since grain is neither produced (as in the PIK program) nor marketed. The calculation of these effects is straightforward. The total diverted acres multiplied by the average yield and price for all wheat in Montana yields an estimate of the total value of wheat foregone due to the (hypothetical) diversion program. This figure is programmed into MIOM as a negative output shock. Once again, it is assumed that farm proprietors' incomes do not fall with the decline in production.

The methodology thus far, overstates the net impact of such a setaside because idled land would have to be placed in some conserving use practice.

As before, it is assumed that one-third the input usage normally required for wheat production would be necessary to comply with this requirement (Johnson). Therefore, positive output shocks on inputs needed for conservation practices were programmed into MIOM. This was done for all sectors necessary for wheat production except for grain transportation and grain storage construction. These two inputs would not be needed for conserving use practices. In addition, it is assumed that the real estate sector, which primarily consists of land mortgage payments and rent payments to landlords, would not be significantly affected by the program in the short run. The aggregate net impact of the diversion program would be the combination of the negative output shock in wheat production (which has negative indirect effects on all inputs) and the positive output shocks in the sectors impacted by conservation use practices.

Table 6.5 presents the results of a hypothetical diversion program where normal fallow cannot be used as diverted acreage (as outlined above) and the PIK program (as discussed in the previous section). The direct impact of the diversion on Agriculture is estimated to be 118.8 million dollars, a much larger figure than the direct impact of the PIK program. This occurs because no production takes place in the diversion program while "production" occurs with the PIK program (due to remuneration to participants from grain stocks). Obviously, real production does not occur in either case. Therefore, these direct effects are merely used by MIOM to generate the appropriate impacts on the rest of the economy.

The output impact on the economy (net of the direct effect) is slightly larger for the diversion program. This reflects the method of payment to farmers. In the diversion program, farmers do not need to purchase marketing inputs. The total output loss to the Montana economy of these two

Table 6.5. Simulated Impact of the Hypothetical Diversion and Payment-In-Kind Programs For Wheat in Montana If Producers Were Required to Idle Intended Crop Acreage, 1983[a]

Sector	Output			Wages			Employment		
	Diversion	PIK	Total	Diversion	PIK	Total	Diversion	PIK	Total
	(- - - - - - - - -	$ million	- - - - - - - - -)				(- - - -	no.	- - - -)
Agriculture[b]	9.3	6.5	15.8	0.3	0.4	0.7	167	124	291
Agricultural services, forestry & fisheries	1.2	1.5	2.7	0.6	0.7	1.3	82	99	181
Mining	3.7	4.3	8.0	0.6	0.8	1.4	23	27	50
Construction	1.4	2.0	3.4	1.1	1.5	2.6	45	64	109
Manufacturing	12.7	14.5	27.2	0.6	0.7	1.3	30	34	64
Transportation & public utilities	3.7	3.2	6.9	1.1	0.7	1.8	46	34	80
Wholesale	3.3	4.5	7.8	1.4	2.0	3.4	79	117	196
Retail Trade	1.7	1.9	3.6	0.8	0.8	1.6	71	79	150
Finance, insurance, & real estate	7.3	3.8	11.1	1.3	1.0	2.3	80	59	139
Services	3.4	3.8	7.2	1.2	1.4	2.6	98	110	208
Government	0.4	0.4	0.8	0.1	0.1	0.2	3	4	7
Total - Net of Direct Impact[c]	48.2	46.5	94.7	8.9	10.0	18.9	724	749	1,473
Direct Impact - Agriculture	118.8	25.3	144.1	0.0	0.0	0.0	1,938	412	2,350
Total	166.9	71.8	238.7	8.9	10.0	18.9	2,662	1,161	3,823

a. All figures shown are negative numbers, resulting from production decreases caused by the programs.

b. The figures for agriculture reflect changes as a result of netting out the direct change in wheat output.

c. Totals may not add due to rounding.

programs is estimated to be 94.7 million dollars (net of the direct effect). The total wage loss amounts to 18.9 million dollars and the total employment loss is 1,473 FTE positions in the simulations. The diversion program would have resulted in total state taxes being reduced by $1,524,503 and a loss of $2,007,869 of local tax revenues.

Comparisons of the costs of each program on the economy are interesting, but may not emphasize the differential effects of each since more acreage (and hence, bushels) were actually enrolled in the PIK program than the diversion program in 1983. Therefore, Table 6.6 compares each program and provides estimated totals on a per bushel basis. Output and wages are reported in dollars per bushel while employment is reported in FTE positions per one million bushels. The total output impact (net of the direct effect) shows that the simulated impacts of the hypothetical diversion program are slightly more costly than those simulated for the actual PIK program. This is particularly true in the Finance, insurance, and real estate sector. The estimated total output impact of the hypothetical combination of farm programs on the Montana economy amounts to $2.58 per bushel enrolled.

Total wages foregone are slightly higher for the diversion program -- 26 cents per bushel versus 25 cents for PIK. In addition, the diversion program caused a slightly larger employment loss than did the PIK program in the simulations -- 20.85 FTE positions per million bushels versus 19.10 FTE positions per million bushels, respectively.

Simulated Impact of a Hypothetical Barley Diversion Program

Up to this point, an analysis of a hypothetical wheat diversion program has been simulated. However, similar effects can be expected if the barley

Table 6.6. Simulated Comparative Costs of the Hypothetical Diversion and Payment-In-Kind Programs For Wheat in Montana If Producers Were Required to Idle Intended Crop Acreage, 1983[a].

Sector	Output			Wages			Employment		
	Diversion	PIK	Total	Diversion	PIK	Total	Diversion	PIK	Total
	(- - - - - - - - - - - $/bu.	- - - -	- - -	- - -	- - -	- - -)	(- - no./mil. bu.- -)		
Agriculture[b]	0.27	0.17	0.44	0.01	0.01	0.02	4.81	3.16	7.97
Agricultural services, forestry & fisheries	0.03	0.04	0.08	0.02	0.02	0.04	2.36	2.52	4.88
Mining	0.11	0.11	0.22	0.02	0.02	0.04	0.66	0.69	1.35
Construction	0.04	0.05	0.09	0.03	0.04	0.07	1.30	1.63	2.92
Manufacturing	0.37	0.37	0.74	0.02	0.02	0.04	0.86	0.87	1.73
Transportation & public utilities	0.11	0.08	0.19	0.03	0.02	0.05	1.32	0.87	2.19
Wholesale	0.10	0.11	0.21	0.04	0.05	0.09	2.28	2.98	5.26
Retail Trade	0.05	0.05	0.10	0.02	0.02	0.04	2.04	2.01	4.05
Finance, insurance, & real estate	0.21	0.10	0.31	0.04	0.03	0.07	2.30	1.50	3.80
Services	0.10	0.10	0.20	0.03	0.04	0.07	2.82	2.80	5.62
Government	0.01	0.01	0.02	0.00	0.00	0.00	0.09	0.10	0.19
Total - Net of Direct Impact[c]	1.39	1.19	2.58	0.26	0.25	0.51	20.85	19.10	39.95
Direct Impact - Agriculture	3.42	0.65	4.07	0.00	0.00	0.00	55.82	10.51	66.33
Total	4.81	1.83	6.64	0.26	0.25	0.51	76.67	29.60	106.27

a. For the diversion programs, the comparative cost is the reduction in output, wages, and employment from Table 6.5 divided by the total diverted production (34,721,700 bu.). For the PIK program the output, wages, and employment reductions from Table 6.4 are divided by 39,217,600 bu.

b., c. See notes on Table 6.5.

setaside program were rewritten so as to not allow fallow acreage to be used as the setaside land. Whereas the actual 1983 barley diversion program caused little change in economic activity, an actual reduction in planted acreage could have significant impacts.

The calculation of the hypothetical impacts on the economy parallels that of the hypothetical wheat diversion program. The acres enrolled are multiplied by the average yield per acre and price per bushel of Montana barley for 1983. This figure is entered as an estimate of the negative output disturbance into MIOM. It is once again assumed that one-third of the usual inputs necessary for barley production would be needed to maintain idled land in a conserving use practice. These effects are entered as positive output shocks.

The effects of such a program are reported in Table 6.7. The total output reduction of the economy (net of the direct effect) is estimated at 10.3 million dollars. Wages would have been decreased by 2 million dollars and employment by 161 FTE positions. The Manufacturing and Agriculture sectors display the largest estimated output effects - 2.9 and 1.8 million dollars, respectively. The highest wage loss occurred in Wholesale trade. Full-time equivalent positions foregone in the simulation were largest in the Agriculture, Services and Wholesale trade sectors. Total state and local tax revenues are estimated to have been reduced by $217,459 and $419,144, respectively.

Table 6.8 presents the estimated costs reported in Table 6.7 in dollars per bushel for output and wages and employment in FTE positions per one million bushels. The simulated total output reduction, net of the direct impact, is $1.03 per bushel. The largest output reductions, per bushel, occur in the Manufacturing, Agriculture, and Finance sectors. Total wages

Table 6.7. Simulated Impact of a Hypothetical Diversion Program For Barley in Montana, 1983[a]

Sector	Output ($ million)	Wages ($ million)	Employment (No.)
Agriculture[b]	1.8	0.1	36
Agricultural services, forestry & fisheries	0.2	0.1	16
Mining	0.9	0.2	6
Construction	0.3	0.2	8
Manufacturing	2.9	0.2	8
Transportation & public utilities	1.0	0.3	13
Wholesale	0.9	0.4	21
Retail Trade	0.4	0.2	16
Finance, insurance, & real estate	1.1	0.2	14
Services	0.8	0.3	22
Government	0.1	0.0	1
Total - Net of Direct Impact[c]	10.3	2.0	161
Direct Impact - Agriculture	24.2	0.0	395
Total	34.5	2.0	556

a. All figures shown are negative numbers, resulting from production decreases caused by the program.

b. The figures for agriculture reflect changes as a result of netting out the direct change in barley output.

c. Totals may not add due to rounding.

Table 6.8. Simulated Per Bushel Costs of the Hypothetical Diversion Program For Barley in Montana, 1983[a].

Sector	Output ($/bu)	Wages ($/bu)	Employment (No./mil. bu.)
Agriculture[b]	0.18	0.01	3.61
Agricultural services, forestry & fisheries	0.02	0.01	1.60
Mining	0.09	0.02	0.60
Construction	0.03	0.02	0.80
Manufacturing	0.29	0.02	0.80
Transportation & public utilities	0.10	0.03	1.30
Wholesale	0.09	0.04	2.10
Retail Trade	0.04	0.02	1.60
Finance, insurance, & real estate	0.11	0.02	1.40
Services	0.08	0.03	2.20
Government	0.01	0.00	0.10
Total - Net of Direct Impact[c]	1.03	0.20	16.13
Direct Impact - Agriculture	2.43	0.00	39.58
Total	3.46	0.20	55.72

a. The per bushel cost is the reduction in output, wages, and employment from Table 6.7 divided by the total diverted production (9,978,738 bu.).

b., c. See notes on Table 6.7.

foregone amounted to 20 cents per bushel enrolled and 16.13 FTE positions were lost for every one million bushels. The largest estimated wage impact occurred in Wholesale trade while the largest employment impact was in Agriculture.

A summary of the simulated output and wage losses, as a result of the hypothetical wheat and barley diversion programs and the actual PIK program for 1983, is presented in Table 6.9. This table is an abbreviated summary of Tables 6.5 and 6.7. Many of the differential impacts between the programs can be attributed to the amount of participation in each. However, the total impacts of the farm programs can be clearly observed. Program simulations calculated total output impacts (net of the direct effect) of 105 millien dollars and total wage reductions of 20.9 million dollars. A comparison of these two figures to those presented in Table 6.1 (which estimates the total impact that the actual 1983 farm program had on the Montana economy) -- 46.5 and 10.0 million dollars -- readily stresses the impact on Montana of what may appear to be a minor revision in farm policy. If the diversion program were revised to prevent the use of fallow acreage as diversion acreage, a substantial negative impact on the Montana economy would occur.

Simulation of the Impact of a Beef Packing Facility on the Montana Wheat and Barley Sectors

There has been substantial interest and discussion, in recent years, concerning the possibility of establishing a major meat packing plant in Montana. There are many factors to be considered. One of the benefits extolled by proponents of such a venture is that the feed grain industry would be favorably impacted, thus grain producers could face incentives to

Table 6.9. Summary of the Hypothetical Wheat and Barley Diversion Programs and Payment-In-Kind Program For Wheat in Montana, 1983[a].

Sector	Output				Wages			
	Barley Diversion	Wheat Diversion	PIK	Total	Barley Diversion	Wheat Diversion	PIK	Total
	(- - - - - $ million			- - - - -)	(- - - - - $ million			- - - - -)
Agriculture[b]	1.8	9.3	6.5	17.6	0.1	0.3	0.4	0.8
Agricultural services, forestry & fisheries	0.2	1.2	1.5	2.9	0.1	0.6	0.7	1.4
Mining	0.9	3.7	4.3	8.9	0.2	0.6	0.8	1.6
Construction	0.3	1.4	2.0	3.7	0.2	1.1	1.5	2.8
Manufacturing	2.9	12.7	14.5	30.1	0.2	0.6	0.7	1.5
Transportation & public utilities	1.0	3.7	3.2	7.9	0.3	1.1	0.7	2.1
Wholesale	0.9	3.3	4.5	8.7	0.4	1.4	2.0	3.8
Retail Trade	0.4	1.7	1.9	4.0	0.2	0.8	0.8	1.8
Finance, insurance, & real estate	1.1	7.3	3.8	12.2	0.2	1.3	1.0	2.5
Services	0.8	3.4	3.8	8.0	0.3	1.2	1.4	2.9
Government	0.1	0.4	0.4	0.9	0.0	0.1	0.1	0.2
Total - Net of Direct Impact[c]	10.3	48.2	46.5	105.0	2.0	8.9	10.0	20.9
Direct Impact - Agriculture	24.2	118.8	25.3	168.3	0.0	0.0	0.0	0.0
Total	34.5	166.9	71.8	273.2	2.0	8.9	10.0	20.9

a. All figures shown are negative numbers, resulting from production decreases caused by the programs.

b. The figures for agriculture reflect changes as a result of the direct change in wheat/barley output.

c. Totals may not add due to rounding.

support the establishment of a plant. According to supporters these impacts can be separated into two components: (1) an increase in the demand for barley and perhaps some wheat to be used for cattle feeding, and (2) a possible small boost in local prices since grain transportation costs could be lowered. The latter impact, while questionable from an economic theory standpoint (after all, why would a cattle feeder ever pay more to a grain producer for feed than he would have to pay at a nearby elevator, and elevator prices are determined in a national or international market -- the new localized demand for grains would have virtually no impact on such a market), would best be analyzed by using some type of transportation model -- perhaps a linear programming model. However, this is beyond the scope of this study.

On the other hand, since I-O analysis is well suited to identifying intersectoral relationships and the impacts of changes in one sector on other sectors of the economy, the first potential impact can be analyzed using MIOM. In general, a major meat packing facility would need a stable supply of fat cattle. <u>If</u> these cattle were fed within the state, this would place increased demands on feed sources. MIOM was used to simulate the effects of this increased demand by calculating the impact of both small and large packing facilities. These two hypothetical facilities were analyzed under two different assumptions concerning fat cattle supplies. A cautionary note is appropriate at this time. An I-O model can be very helpful in determining the impacts of the establishment of such a facility. However, it is not a substitute for a feasibility study. Many factors other than intersectoral relationships would need to be considered to determine the potential for profitability of such a venture.

The analysis assumes that a plant slaughters and portion cuts beef. The small plant slaughters 75 head per hour (140,625 per year) and processes two thirds of the kill (93,750 head per year) in the portion cut facility. The large plant is assumed to slaughter 110 head per hour (206,250 per year) and processes 140,500 head per year in the portion cut facility.

Table 6.10 reports the estimated changes in output, wages, and employment which would accrue to the barley and wheat sectors of the Montana economy if a beef packing facility was established in Montana. The table presents results of the two different packing plant sizes noted above for two different scenarios. The first scenario assumes that the packing plant would purchase 75% of its fat cattle from within Montana. The second presents the results if a sizeable supply response did not materialize and the packing facility could only purchase 50% of its fat cattle from within the state.

Case one shows that a small facility (employing 217 people) is estimated to result in requirements of $6,562,200 of output from the barley sector and $280,600 from the wheat sector. Using 1983 average prices, this represents an estimated 2.7 million bushel increase in barley production and an 80 thousand bushel increase in wheat production. On a percentage basis, this translates into a 3.5% increase in barley production and a miniscule percentage increase in wheat production over 1983 levels. Obviously, most of this output is in the form of an indirect purchase of feed grain through the direct purchase of grain-fed beef cattle. Wages would be increased in these two sectors a total of $1,054,700 and 111.7 FTE positions would be generated. This analysis assumes that the increases in demand for feed grains results in increased production of grain in Montana, not a transfer of grain from existing out-of-state markets to local markets. No impact would be simulated by MIOM if the latter occurred.

Table 6.10. The Simulated Effects of Two Different Sizes of Meat Packing Plants on the Montana Barley and Wheat Industries.[a]

	Output			Wages			Employment		
	Barley	Wheat	Total	Barley	Wheat	Total	Barley	Wheat	Total
	(- - - - - - - - - - - - $1,000	- - - - - - - - - - - - - -)					(- - - - - - no.- - - - - -)		
CASE ONE[b]									
Small Plant	6,562.2	280.6	6,842.8	1,017.1	37.6	1,054.7	107.1	4.6	111.7
Large Plant	8,558.1	365.9	8,924.0	1,326.5	49.0	1,375.5	139.7	6.0	145.7
CASE TWO[c]									
Small Plant	3,876.7	169.8	4,046.5	600.9	22.8	623.7	63.3	2.8	66.1
Large Plant	5,055.8	221.5	5,277.3	783.7	29.7	813.4	82.5	3.6	86.1

a. All numbers are positive due to an increase in the demand for wheat and barley.

b. Case One assumes that 75% of the fat cattle needed to operate a packing plant would be supplied from within Montana.

c. Case Two assumes that 50% of the fat cattle needed to operate a packing plant would be supplied from within Montana.

As expected, the simulated effects of a large plant (in this case, a large plant is defined as one which employs 283 people) are greater than those for a smaller plant. Wheat and barley output could be increased by \$8,924,000. Total wages which accrue to wheat and barley producers are estimated to increase by \$1,375,500 and 145.7 FTE positions would be generated in grain production.

The results for the first scenario assume that a significant supply response for fat cattle occurs within the state. The second scenario reports the results if a smaller supply response occurs -- specifically, if only 50% of the fat cattle needed to operate a packing facility were produced in Montana. In this case, the impacts on the wheat and barley sectors are significantly smaller than the former. The estimated total increase in demand for grain would be \$4,046,500 and \$5,277,300 for the small and large plants, respectively. The simulated demand increase caused by the small plant would add \$623,700 of wages to wheat and barley producers while the large plant would add \$813,400. An additional 66.1 FTE positions in wheat and barley production is generated by the simulation of the impact of a small plant. The large plant would add an estimated 86.1 positions.

The results shown in Table 6.10 are quite optimistic and might be regarded as overestimates of the net benefits to grain producers. This is because it was assumed that the establishment of a meat packing facility would result in a net increase in the demand for Montana grain and, hence, increased production. While this may occur to some degree, it is more likely that a portion of grain normally shipped to out-of-state markets would be marketed, instead, to in-state cattle feeders.

Concluding Remarks

This chapter has presented simulated impacts of both actual (e.g. PIK) and hypothetical (e.g. an altered setaside program and a beef packing plant) exogenous shocks to the Montana economy in general and the wheat and barley sectors in specific. Caution in interpreting these results is advised in light of the fact that they are simulated rather than actual. They depend crucially upon the assumptions underlying the way the exogenous shocks were treated in the analysis -- assumptions which were developed in an effort to correspond as closely as possible to actual situations which might apply in the context of such exogenous occurrences, but which were, nonetheless, developed with incomplete and/or imperfect information. The examples developed here are primarily intended to indicate the types of repercussions various exogenously determined changes like government farm policy have, both directly on the grain sector and indirectly on sectors linked to grain production. The magnitudes presented illustrate the general types of impacts that should be anticipated, but they are only estimates of what the actual impacts would be if the assumptions employed in developing the analysis actually were to apply should such changes occur.

Notes

1. Other impacts of PIK might include an increase of the price of wheat. However, a price increase would only alter the value of production foregone and probably would be somewhat uniformly distributed among the input sectors of the economy.
2. Average 1983 yield and prices for all wheat in Montana were obtained from the Montana Crop and Livestock Reporting Service. The number of acres enrolled in PIK were obtained from the Montana Agricultural Stabilization and Conservation Service.
3. It is assumed that net farm incomes remained unchanged as a result of the program. Obviously, some farmers' net farm incomes were increased by participation while others who participated may have received more income by not participating. However, even those of the latter group may have made a rational decision in that they reduced income risk by participating. Given that many farmers did not participate, it seems sensible to assume that the decision was a marginal one and that, overall, net farm incomes remained roughly unchanged. Therefore, MIOM calculates the impact of the program assuming that there are no induced impacts in the wheat production sector.
4. The exception to this process was the real estate sector. The real estate sector is comprised of land mortgage payments and payments to landlords. It is assumed that neither of these two categories were significantly affected by PIK. Therefore, offsetting values are entered into MIOM so that this sector remained unaffected.

5. It may be the case that the PIK program would not have appeared as attractive if the diversion program had been written differently. In this case, the overall impact would have been reduced by lower participation levels.

Chapter 7

Summary and Conclusion

This report has presented the results of the first phase of a two year project investigating the impact of wheat and barley on the Montana economy. An input-output model of Montana was developed and utilized to: (1) analyze the intersectoral linkages between the grain sector and other sectors of the Montana economy; (2) estimate the magnitude of the output, income, and employment impact multipliers for wheat and barley; and (3) evaluate the simulated impact of selected exogenous shocks to the grain sector on the Montana economy.

It is anticipated that the research reported above will be useful in the understanding and planning of Montana's economic development. As the "Build Montana" program matures, this report may be a useful reference when projects related to the grain sector are considered. Of course, many other considerations will also be important in policy developments.

The theory and methodology of input-output analysis was developed, at length, in the early chapters of this report. An attempt was made to make the reading of the report as self-contained as possible. Assumptions and limitations of input-output analysis were noted and caution exercised in interpreting the results. While the understanding of these concepts may require tedious study, it should not be avoided (improper interpretation and usage of input-output analysis results are frequent, but avoidable). Input-output models are powerful analytical tools that shed considerable light on the workings of a regional economy; but, like all empirical tools in economics, a failure to grasp at least a rudimentary understanding of the technique will often lead to misunderstanding.

This study suggests that wheat and barley production is an important component of the Montana economy. Further, analysis of the intersectoral linkages and simulations of various government policies indicate that the ripple effects of changes in one sector on other sectors can be large. However, it is also apparent that, from time to time, these impacts have been overstated (on occasion, impact multipliers ranging from 6 to 8 have been reported in Montana's press, in contrast to the multipliers reported in Chapter 5).

In discussing the importance of a sector or sectors to an economy, too much emphasis can be placed on the size of the impact multipliers. Certainly, increases in the output of an industry with large multipliers can have substantial positive impacts on the other sectors in the economy. However, when output of these high impact industries is <u>negatively</u> affected, the converse is true. There will be a substantial <u>depressing impact</u> on the economy. (The recent experience with the automobile industry in Michigan provides a case in point.) While the multipliers for wheat and barley are not large, they compare favorably with many other sectors of the Montana economy. More important, however, is that wheat and barley production is a relatively stable industry that can be counted on to yield positive economic benefits to the Montana economy for years to come.

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APPENDICES

Appendix Table A. The Sector Name and The Wheat and Barley Column Coefficients of MIOM

NO.	SECTOR NAME	WHEAT COLUMN	BARLEY COLUMN
1	DAIRY FARM PRODUCTS, POULTRY, & EGGS	.001459	.014843
2	MEAT ANIMALS AND MISC. LIVESTOCK	.029527	.033188
3	FOOD GRAINS	.060726	.000000
4	FEED GRAINS	.000048	.030371
5	SUGAR CROPS	.000000	.000000
6	MISCELLANEOUS CROPS	.000000	.000645
7	FOREST PRODUCTS	.000000	.000000
8	GREENHSE & NURSERY PRODS	.000042	.000050
9	FORESTRY AND FISHERY PRODUCTS	.000008	.000010
10	AGRIC FOREST & FISHERY SERVS	.013320	.012613
11	FERROUS AND NONFERROUS ORES MINING	.000000	.000000
12	COAL MINING	.000000	.000000
13	CRUDE PETROLEUM AND NATURAL GAS	.000000	.000000
14	STONE-CLAY MIN + MINERAL QUARRYING	.009115	.013526
15	MAINTENANCE AND REPAIR CONSTRUCTION	.015115	.012929
16	GENERAL CONTRACTORS	.000000	.000000
17	HIGHWAY AND STREET CONSTRUCTION	.000000	.000000
18	HEAVY CONSTRUCTION	.000000	.000000
19	SPECIAL TRADE CONTRACTORS, N.E.C.	.000000	.000000
20	PLUMBING,HEATING, & AIR COND. CONT.'S	.000000	.000000
21	ELECTRICAL CONTRACTORS	.000000	.000000
22	COMPLETE GUIDED MISSILES	.000000	.000000
23	AMMUNITION, EXC. SMALL ARMS	.000000	.000000
24	TANKS & TANK COMPONENTS	.000000	.000000
25	SMALL ARMS	.000000	.000000
26	SMALL ARMS AMMUNITION	.000000	.000000
27	OTH ORDNANCE & ACCESS	.000000	.000000
28	MEAT PACKING PLANTS	.000000	.000000
29	SAUSAGES & OTH PREP MEATS	.000000	.000000
30	POULTRY DRESSING PLANTS	.000000	.000000
31	POULTRY & EGG PROCESSING	.000000	.000000
32	CREAMERY BUTTER	.000000	.000000
33	CHEESE, NATURAL & PROCESSED	.000000	.000000
34	MILK, CONDENSED&EVAPORATED	.000000	.000000
35	ICE CREAM AND FROZEN DESSERTS	.000000	.000000
36	FLUID MILK	.000000	.000000
37	CANNED & CURED SEA FOODS	.000000	.000000
38	CANNED SPECIALTIES	.000000	.000000
39	CANNED FRUITS & VEGETABLES	.000000	.000000
40	DEHYDRATED FOOD PRODUCTS	.000000	.000000
41	PICKLES, SAUCES, SALAD DRESS	.000000	.000000
42	FISH, FRESH OR FROZEN PKGD	.000000	.000000
43	FROZEN FRUITS & VEGETABLES	.000000	.000000
44	FLOUR & OTH GRAIN MILL PROD	.000005	.000005
45	CEREAL PREPARATIONS	.000000	.000000

Appendix Table A. (continued)

NO.	SECTOR NAME	WHEAT COLUMN	BARLEY COLUMN
46	BLENDED & PREPARED FLOUR	.000000	.000000
47	DOG, CAT, & OTH PET FOOD	.000000	.000000
48	PREPARED FEEDS, N.E.C.	.000000	.000000
49	RICE MILLINGS	.000000	.000000
50	WET CORN MILLING	.000000	.000000
51	BREAD, CAKE, & RLTD PRODS	.000000	.000000
52	COOKIES & CRACKERS	.000000	.000000
53	SUGAR	.000000	.000000
54	CONFECTIONERY PRODUCTS	.000000	.000000
55	CHOCOLATE & COCOA PRODS	.000000	.000000
56	CHEWING GUM	.000000	.000000
57	MALT LIQUORS	.000000	.000000
58	MALT	.000000	.000000
59	WINES BRANDY & BRANDY SPIRITS	.000000	.000000
60	DISTILLED LIQ, EXC BRANDY	.000000	.000000
61	BOTTLED & CANNED SOFT DRINKS	.000000	.000000
62	FLAVOR EXTRACTS & SIRUPS, NEC	.000000	.000000
63	COTTONSEED OIL MILLS	.000000	.000000
64	SOYBEAN OIL MILLS	.000000	.000000
65	VEGETABLE OIL MILLS, NEC	.000000	.000000
66	ANIMAL & MARINE FATS & OILS	.000000	.000000
67	ROASTED COFFEE	.000000	.000000
68	SHORTENING & COOKING OILS	.000000	.000000
69	MANUFACTURED ICE	.000000	.000000
70	MACARONI & SPAGHETTI	.000000	.000000
71	FOOD PREPARATIONS, N.E.C.	.000000	.000000
72	CIGARETTES	.000000	.000000
73	CIGARS	.000000	.000000
74	CHEWING & SMOKING TOBACCO	.000000	.000000
75	TOBACCO STEM & REDRYING	.000000	.000000
76	BRDWOV FAB MILLS & FABRIC FIN PLT	.000000	.000000
77	NARROW FABRIC MILLS	.000000	.000000
78	YARN MILLS & TEX FIN NEC	.000000	.000000
79	THREAD MILLS	.000000	.000000
80	FLOOR COVERINGS	.000000	.000000
81	FELT GOODS N.E.C.	.000000	.000000
82	LACE GOODS	.000000	.000000
83	PADDING & UPHOLSTERY FILLING	.000000	.000000
84	PROCESSED TEXTILE WASTE	.000000	.000000
85	COATED FAB, NOT RUBBERIZED	.000000	.000000
86	TIRE CORD & FABRIC	.000000	.000000
87	CORDAGE & TWINE	.000000	.000010
88	NONWOVEN FABRICS	.000000	.000000
89	TEXTILE GOODS, N.E.C.	.000000	.000000
90	WOMENS HOSIERY, EXC SOCKS	.000000	.000000

Appendix Table A. (continued)

NO.	SECTOR NAME	WHEAT COLUMN	BARLEY COLUMN
91	HOSIERY, N.E.C.	.000000	.000000
92	KNIT OUTERWEAR MILLS	.000000	.000000
93	KNIT UNDERWEAR MILLS	.000000	.000000
94	KNITTING MILLS, N.E.C.	.000000	.000000
95	KNIT FABRIC MILLS	.000000	.000000
96	APPAREL FROM PURCHASED MATLS	.000000	.000000
97	CURTAINS & DRAPERIES	.000000	.000000
98	HOUSEFURNISHINGS, N.E.C.	.000000	.000000
99	TEXTILE BAGS	.000000	.000000
100	CANVAS PRODUCTS	.000007	.000005
101	PLEATING & STITCHING	.000000	.000000
102	AUTO & APPAREL TRIMMINGS	.000000	.000000
103	SCHIFFLI MACH EMBROIDERIES	.000000	.000000
104	FAB TEXTILE PRODUCTS, NEC	.000000	.000000
105	LOGGING CAMPS & CONTRACTORS	.000000	.000000
106	SAWMILLS & PLANING MILLS, GENL	.000000	.000000
107	HRDWD DIM & FLOOR MILLS	.000000	.000000
108	SPEC PROD SAWMILLS NEC	.000000	.000000
109	MILLWORK	.000000	.000000
110	WOOD KITCHEN CABINETS	.000000	.000000
111	VENEER & PLYWOOD	.000000	.000000
112	STRUC WOOD MEMBERS, NEC	.000000	.000000
113	PREFAB WOOD BUILDINGS	.000000	.000000
114	WOOD PRESERVING	.000000	.000000
115	WOOD PALLETS & SKIDS	.000000	.000000
116	PARTICLEBOARD	.000000	.000000
117	WOOD PRODUCTS, N.E.C.	.000000	.000092
118	WOOD CONTAINERS	.000000	.000000
119	WOOD HOUSEHOLD FURNITURE	.000000	.000000
120	HOUSEHOLD FURNITURE, NEC	.000000	.000000
121	WOOD TV & RADIO CABINETS	.000000	.000000
122	UPHOLSTERED HSHLD FURN	.000000	.000000
123	METAL HOUSEHOLD FURNITURE	.000000	.000000
124	MATTRESSES & BEDSPRINGS	.000000	.000000
125	WOOD OFFICE FURNITURE	.000000	.000000
126	METAL OFFICE FURNITURE	.000000	.000000
127	PUBLIC BUILDING FURNITURE	.000000	.000000
128	WOOD PARTITIONS & FIXTURES	.000000	.000000
129	METAL PARTITIONS & FIXTURES	.000000	.000000
130	BLINDS, SHADES, & DRAPE HRDWRE	.000000	.000000
131	FURNITURE & FIXTURES, NEC	.000000	.000000
132	PULP MILLS	.000000	.000000
133	PAPER MILLS, EXC BLDG PAPER	.000000	.000000
134	PAPERBOARD MILLS	.000000	.000000
135	ENVELOPES	.000000	.000000

Appendix Table A. (continued)

NO.	SECTOR NAME	WHEAT COLUMN	BARLEY COLUMN
136	SANITARY PAPER PRODUCTS	.000000	.000000
137	BUILDING PAPER & BOARD MILLS	.000000	.000000
138	PAPER COATING & GLAZING	.000000	.000000
139	BAGS, EXCEPT TEXTILES	.000000	.000000
140	DIE-CUT PAPER & BOARD	.000000	.000000
141	PRESSED & MOLDED PULP GOODS	.000000	.000000
142	STATIONERY PRODUCTS	.000000	.000000
143	CONVERTED PAPER PROD, NEC.	.000000	.000000
144	PAPERBOARD CONTAINERS & BOXES	.000019	.000023
145	NEWSPAPERS	.000000	.000000
146	PERIODICALS	.000000	.000019
147	BOOK PUBLISHING	.000000	.000000
148	BOOK PRINTING	.000000	.000000
149	MISC. PUBLISHING	.000003	.000004
150	COMMERCIAL PRINTING	.000010	.000009
151	LITHOGRAPHIC PLATEMAKING & SERVIC	.000000	.000000
152	MANIFOLD BUSINESS FORMS	.000000	.000000
153	BLANKBOOKS & LOOSELEAF BINDERS	.000003	.000004
154	GREETING CARD PUBLISHING	.000000	.000000
155	ENGRAVING & PLATE PRINTING	.000000	.000000
156	BOOKBINDING & RELATED WORK	.000000	.000000
157	TYPESETTING	.000000	.000000
158	PHOTOENGRAVING	.000000	.000000
159	ELECTROTYPING & STEREOTYPING	.000000	.000000
160	INDL CHEM, INORG & ORG	.004920	.009648
161	FERTILIZERS, NITROG&PHOSPHATE	.000000	.000000
162	FERTILIZERS MIXING ONLY	.002064	.002591
163	AGRIC CHEMICALS, NEC	.002852	.005886
164	GUM & WOOD CHEMICALS	.000000	.000000
165	ADHESIVES & SEALANTS	.000000	.000000
166	EXPLOSIVES	.000000	.000000
167	PRINTING INK	.000000	.000000
168	CARBON BLACK	.000000	.000000
169	CHEMICAL PREPARATIONS,NEC	.000001	.000054
170	PLASTICS MATLS & RESINS	.000000	.000000
171	SYNTHETIC RUBBER	.000000	.000000
172	CELLULOSIC MAN-MADE FIBERS	.000000	.000000
173	NONCELLULOSIC FIBERS	.000000	.000000
174	DRUGS	.000000	.000000
175	SOAP & OTHER DETERGENTS	.000000	.000000
176	POLISHES & SANITATION GOODS	.000000	.000000
177	SURFACE ACTIVE AGENTS	.000000	.000000
178	TOILET PREPARATIONS	.000000	.000000
179	PAINTS & ALLIED PRODUCTS	.000001	.000000
180	PETROLEUM REFINING	.078777	.080714

Appendix Table A. (continued)

NO.	SECTOR NAME	WHEAT COLUMN	BARLEY COLUMN
181	PAVING MIXTURES & BLOCKS	.000000	.000000
182	ASPHALT FELTS & COATINGS	.000000	.000000
183	TIRES & INNER TUBES	.000000	.000000
184	RUBBER & PLASTIC FOOTWEAR	.000000	.000000
185	RECLAIMED RUBBER	.000000	.000000
186	FABRICATED RUBBER PROD,NEC	.000000	.000000
187	MISC.PLASTIC PRODUCTS	.000000	.000001
188	RUBBER&PLASTIC HOSE&BELTING	.000000	.000000
189	LEATHER TANNING & FINISHING	.000000	.000000
190	FOOTWEAR CUT STOCK	.000000	.000000
191	SHOES, EXCEPT RUBBER	.000000	.000000
192	HOUSE SLIPPERS	.000000	.000000
193	LEATHER GLOVES & MITTENS	.000000	.000000
194	LUGGAGE	.000000	.000000
195	WOMENS HANDBAGS & PURSES	.000000	.000000
196	PERSONAL LEATHER GOODS	.000000	.000000
197	LEATHER GOODS, N.E.C.	.000000	.000001
198	GLASS & GLASS PROD,NEC	.000001	.000002
199	GLASS CONTAINERS	.000000	.000000
200	CEMENT, HYDRAULIC	.000000	.000000
201	BRICK & STRUCTURAL CLAY TILE	.000000	.000000
202	CERAMIC WALL & FLOOR TILE	.000000	.000000
203	CLAY REFRACTORIES	.000000	.000000
204	STRUCTURAL CLAY PROD,NEC	.000000	.000000
205	VITREOUS PLUMBING FIXTURES	.000000	.000000
206	VITREOUS CHINA FOOD UTENSILS	.000000	.000000
207	FINE EARTHWARE FOOD UTENSILS	.000000	.000000
208	PORCELAIN ELEC SUPPLIES	.000000	.000000
209	POTTERY PRODUCTS, N.E.C.	.000000	.000000
210	CONCRETE BLOCK & BRICK	.000000	.000000
211	CONCRETE PRODUCTS, N.E.C.	.000000	.000000
212	READY-MIXED CONCRETE	.000000	.000000
213	LIME	.000037	.000043
214	GYPSUM PRODUCTS	.000000	.000000
215	CUT STONE & STONE PRODUCTS	.000000	.000000
216	ABRASIVE PRODUCTS	.000000	.000000
217	ASBESTOS PRODUCTS	.000000	.000000
218	GASKETS, PACK&SEAL DEVICES	.000000	.000000
219	MINERALS, GROUND OR TREATED	.000000	.000387
220	MINERAL WOOL	.000000	.000000
221	NONCLAY REFRACTORIES	.000000	.000000
222	NONMETAL MINERAL PROD, NEC	.000000	.000000
223	BLAST FURNACES & STEEL MILLS	.000000	.000000
224	ELECTROMETALLURGICAL PRODUCTS	.000000	.000000
225	STEEL WIRE & RELATED PRODUCTS	.000000	.000000

Appendix Table A. (continued)

NO.	SECTOR NAME	WHEAT COLUMN	BARLEY COLUMN
226	COLD FINISHING OF STEEL SHAPES	.000000	.000000
227	STEEL PIPE & TUBES	.000000	.000000
228	IRON & STEEL FOUNDRIES	.000000	.000000
229	IRON & STEEL FORGINGS	.000000	.000000
230	METAL HEAT TREATING	.000000	.000000
231	PRIMARY METAL PROD,NEC	.000000	.000000
232	PRIMARY COPPER	.000000	.000000
233	PRIMARY LEAD	.000000	.000000
234	PRIMARY ZINC	.000000	.000000
235	PRIMARY ALUMINUM	.000000	.000000
236	PRIMARY NF METALS, NEC	.000000	.000000
237	SECONDARY NONFERROUS METALS	.000000	.000000
238	COPPER ROLLING & DRAWING	.000000	.000000
239	ALUMINUM ROLLING & DRAWING	.000000	.000000
240	NONFERROUS ROLL & DRAW,NEC	.000000	.000000
241	NF WIRE DRAWING&INSULATING	.000000	.000000
242	ALUMINUM CASTINGS	.000000	.000000
243	BRASS,BRONZE,COPPER CASTINGS	.000000	.000000
244	NONFERROUS CASTINGS,NEC	.000000	.000000
245	NONFERROUS FORGINGS	.000000	.000000
246	METAL CANS	.000000	.000000
247	METAL BARRELS,DRUMS,PAILS	.000000	.000000
248	METAL SANITARY WARE	.000000	.000000
249	PLUMBING FIXTURES, ETC	.000000	.000000
250	HEATING EQUIP,EXC ELEC	.000000	.000000
251	FABRICATED STRUCTURAL METAL	.000000	.000000
252	METAL DOORS,SASH,TRIM	.000000	.000000
253	BOILER SHOPS	.000000	.000044
254	SHEET METAL WORK	.000000	.000000
255	ARCHITECTURAL METAL WORK	.000000	.000000
256	PREFAB METAL BUILDINGS	.000000	.000000
257	MISCELLANEOUS METAL WORK	.000000	.000000
258	SCREW MACH PROD,BOLTS,NUTS	.000000	.000000
259	AUTO STAMPINGS	.000000	.000000
260	CROWNS & CLOSURES	.000000	.000000
261	METAL STAMPINGS, N.E.C.	.000000	.000000
262	CUTLERY	.000000	.000000
263	HAND & EDGE TOOLS, NEC	.000022	.000020
264	HAND SAWS & SAW BLADES	.000000	.000000
265	HARDWARE, N.E.C.	.000000	.000000
266	PLATING & POLISHING	.000000	.000000
267	METAL COATING & ALLIED SERVICES	.000000	.000000
268	MISC FAB WIRE PROD	.000000	.000000
269	STEEL SPRINGS, EXC WIRE	.000000	.000000
270	PIPE,VALVES,PIPE FITTINGS	.000000	.000000

Appendix Table A. (continued)

NO.	SECTOR NAME	WHEAT COLUMN	BARLEY COLUMN
271	METAL FOIL & LEAF	.000000	.000000
272	FABRICATED METAL PROD,NEC	.000021	.000024
273	STEAM ENGINES & TURBINES	.000000	.000000
274	INTERNAL COMBUST ENGINES,NEC	.000000	.000000
275	FARM MACHINERY & EQUIP.	.002925	.003382
276	LAWN & GARDEN EQUIP.	.000000	.000000
277	CONSTRUCTION MACH & EQUIP.	.000000	.000000
278	MINING MACH,EXC OIL FIELD	.000000	.000000
279	OIL FIELD MACHINERY	.000000	.000000
280	ELEVATORS & MOVING STAIRWAYS	.000000	.000000
281	CONVEYERS & CONVEYING EQUIPMENT	.000000	.000000
282	HOIST, CRANES, & MONORAILS	.000000	.000000
283	INDL TRUCKS & TRACTORS	.000000	.000000
284	MACH TOOLS, METAL CUTTING	.000000	.000000
285	MACH TOOLS, METAL FORMING	.000000	.000000
286	SPEC DIES,TOOLS,MACH TOOL ACC	.000000	.000000
287	POWER DRIVEN HAND TOOLS	.000000	.000000
288	ROLLING MILL MACHINERY	.000000	.000000
289	METALWORKING MACHINERY	.000000	.000000
290	FOOD PRODUCTS MACHINERY	.000000	.000000
291	TEXTILE MACHINERY	.000000	.000000
292	WOODWORKING MACHINERY	.000000	.000000
293	PAPER INDUSTRIES MACHINERY	.000000	.000000
294	PRINTING TRADES MACHINERY	.000000	.000000
295	SPECIAL INDL MACH,NEC	.000000	.000000
296	PUMPS & COMPRESSORS	.000000	.000000
297	BALL & ROLLER BEARINGS	.000000	.000000
298	BLOWERS & FANS	.000000	.000000
299	INDUSTRIAL PATTERNS	.000000	.000000
300	POWER TRANSMISSION EQUIPMENT	.000000	.000000
301	INDL FURNACES & OVENS	.000000	.000000
302	GENL INDL MACH, NEC	.000000	.000000
303	CARBURETORS,PISTONS,RINGS,VALVES	.000000	.000000
304	NON-ELEC MACHINERY,NEC	.000004	.000002
305	ELECTRONIC COMPUTING EQUIPMENT	.000000	.000000
306	CALC & ACCOUNTING MACH	.000000	.000000
307	TYPEWRITERS	.000000	.000000
308	SCALES & BALANCES	.000000	.000000
309	OFFICE MACHINES, N.E.C.	.000000	.000000
310	AUTOMATIC MERCHANDIS MACHINES	.000000	.000000
311	COMMERCIAL LAUNDRY EQUIPMENT	.000000	.000000
312	REFRIG & HEATING EQUIPMENT	.000000	.000000
313	MEASUR & DISPENS PUMPS	.000000	.000000
314	SERVICE IND MACH, NEC	.000000	.000000
315	INSTRUM TO MEASURE ELEC	.000000	.000000

Appendix Table A. (continued)

NO.	SECTOR NAME	WHEAT COLUMN	BARLEY COLUMN
316	TRANSFORMERS	.000000	.000000
317	SWITCHGEAR&SWITCHBOARD APPARTUS	.000000	.000000
318	MOTORS & GENERATORS	.000000	.000000
319	INDUSTRIAL CONTROLS	.000000	.000000
320	WELDING APPARTUS, ELECTRIC	.000000	.000000
321	CARBON & GRAPHITE PRODUCTS	.000000	.000000
322	ELEC INDL APPARATUS, NEC	.000000	.000000
323	HOUSEHOLD COOKING EQUIPMENT	.000000	.000000
324	HHLD REFRIG, FREEZERS	.000000	.000000
325	HOUSEHOLD LAUNDRY EQUIPMENT	.000000	.000000
326	ELEC HOUSEWARES & FANS	.000000	.000000
327	HHLD VACUUM CLEANERS	.000000	.000000
328	SEWING MACHINES	.000000	.000000
329	HOUSEHOLD APPLIANCES,NEC	.000000	.000000
330	ELECTRIC LAMPS	.000000	.000000
331	LIGHTING FIXTURES & EQUIPMENT	.000000	.000000
332	WIRING DEVICES	.000000	.000000
333	RADIO & TV RECEIVING SETS	.000000	.000000
334	PHONOGRAPH RECORDS & TAPE	.000000	.000000
335	TELEPHONE & TELEGRAPH APPARATUS	.000000	.000000
336	RADIO & TV COMMUNIC EQUIPMENT	.000000	.000000
337	ELECTRON TUBES	.000000	.000000
338	SEMICONDUCTORS & RELATED DEVICES	.000000	.000000
339	ELECTRONIC COMPONENTS,NEC	.000000	.000000
340	STORAGE BATTERIES	.000000	.000000
341	PRIMARY BATTERIES,DRY&WET	.000000	.000000
342	X-RAY APPARATUS & TUBES	.000000	.000000
343	ENGINE ELECTRICAL EQUIPMENT	.000000	.000000
344	ELECTRICAL EQUIPMENT	.000001	.000001
345	TRUCK & BUS BODIES	.000000	.000000
346	TRUCK TRAILERS	.000000	.000000
347	MOTOR VEHICLES	.000000	.000000
348	MOTOR VEHICLE PTS&ACCESSORIES	.000000	.000000
349	AIRCRAFT	.000000	.000000
350	AIRCRAFT,MISSILE ENGINES,ENG PTS	.000000	.000000
351	AIRCRAFT,MISSILE EQ,NEC	.000000	.000000
352	SHIP BUILDING & REPAIRING	.000000	.000000
353	BOAT BUILDING & REPAIRING	.000000	.000000
354	RAILROAD EQUIPMENT	.000000	.000000
355	MOTORCYCLES,BICYLES,&PTS	.000000	.000000
356	TRAVEL TRAILERS & CAMPERS	.000000	.000000
357	MOBILE HOMES	.000000	.000000
358	TRANSPORTATION EQUIP,NEC	.000000	.000000
359	ENGINEER & SCI INSTRUMENTS	.000000	.000000
360	MECHANICAL MEASURING DEVICES	.000000	.000000

Appendix Table A. (continued)

NO.	SECTOR NAME	WHEAT COLUMN	BARLEY COLUMN
361	AUTOMAT TEMPERATURE CONTROLS	.000000	.000000
362	SURG & MED INSTRUMENTS	.000000	.000000
363	SURG APPLIANCES & SUPPLIES	.000000	.000000
364	DENTAL EQUIP & SUPPLIES	.000000	.000000
365	WATCHES, CLOCKS, & PARTS	.000000	.000000
366	LENSES, OPTICAL INSTRUMENTS	.000000	.000000
367	OPHTHALMIC GOODS	.000000	.000000
368	PHOTOGRAPHIC EQUIP&SUPPLIES	.000000	.000000
369	JEWELRY, PRECIOUS METAL	.000000	.000000
370	JEWELERS MATL&LAPIDARY WORK	.000000	.000000
371	SILVERWARE & PLATED METAL	.000000	.000000
372	COSTUME JEWELRY	.000000	.000000
373	MUSICAL INSTRUMENTS	.000000	.000000
374	GAMES, TOYS, KIDS' VEHICLES	.000000	.000000
375	DOLLS	.000000	.000000
376	SPORT & ATHLETIC GOODS,NEC	.000000	.000000
377	PENS & MECHANICAL PENCILS	.000000	.000000
378	LEAD PENCILS & ART GOODS	.000000	.000000
379	MARKING DEVICES	.000000	.000000
380	CARBON PAPER & INK RIBBONS	.000000	.000000
381	ARTIFICIAL TREES & FLOWERS	.000000	.000000
382	BUTTONS	.000000	.000000
383	NEEDLES, PINS, & FASTENERS	.000000	.000000
384	BROOMS & BRUSHES	.000000	.000000
385	HARD SURFACE FLOOR COVERINGS	.000000	.000000
386	BURIAL CASKETS & VAULTS	.000000	.000000
387	SIGNS & ADVERTIS DISPLAYS	.000000	.000000
388	MANUFACTURING, N.E.C.	.000000	.000000
389	RAILROADS & RELATED SERVICES	.005992	.006896
390	HWY PASSENGER TRANSIT - LOC & INT	.000049	.000057
391	TRUCKING & WAREHOUSING	.003249	.006924
392	WATER TRANSPORTATION	.000161	.000205
393	AIR TRANSPORTATION	.000067	.000079
394	PIPELINES,EXC NATURAL GAS	.000298	.000317
395	TRANSPORTATION SERVICES	.000016	.000010
396	COMMUNIC, EXC RADIO & TV	.002593	.002251
397	RADIO & TV BROADCASTING	.000006	.000007
398	ELECTRIC UTILITIES	.000123	.000141
399	GAS UTILITIES	.003572	.003513
400	WATER SUPPLY,SANITARY SERVICES	.002980	.006523
401	WHLSALE: AUTO AND OTHER MOTOR VEHICLES	.000000	.000000
402	WHLSALE: AUTO EQUIPMENT	.000073	.000103
403	WHLSALE: TIRES AND TUBES	.001205	.001702
404	WHLSALE: DRUGS & DRUGGISTS' SUNDRIES	.000000	.000000
405	WHLSALE: PAINTS AND VARNISHES	.000000	.000000

Appendix Table A. (continued)

NO.	SECTOR NAME	WHEAT COLUMN	BARLEY COLUMN
406	WHLSALE: CHEMICALS AND ALLIED PRODUCTS	.000640	.000904
407	WHLSALE: DRY GOODS,PIECE GOODS,&NOTIONS	.000000	.000000
408	WHLSALE: APPAREL & ACCESSORIES	.000000	.000000
409	WHLSALE: FOOTWEAR	.000000	.000000
410	WHLSALE: GROCERIES, GENERAL LINE	.000000	.000000
411	WHLSALE: DAIRY PRODUCTS	.000000	.000000
412	WHLSALE: POULTRY	.000000	.000000
413	WHLSALE: CONFECTIONARY	.000000	.000000
414	WHLSALE: FISH & SEAFOODS	.000000	.000000
415	WHLSALE: MEATS	.000000	.000000
416	WHLSALE: FRESH FRUITS & VEGETABLES	.000000	.000000
417	WHLSALE: GROCERIES, N.E.C.	.000000	.000000
418	WHLSALE: FARM PRODUCTS, RAW MATERIALS	.004160	.005880
419	WHLSALE: ELECTRICAL EQUIPMENT	.000035	.000049
420	WHLSALE: ELECTRICAL APPLIANCES	.000000	.000000
421	WHLSALE: ELECTRONIC PARTS AND EQUIP.	.000000	.000000
422	WHLSALE: HARDWARE	.000261	.000369
423	WHLSALE: PLUMB-HEATING; AIR COND, REFRI	.000000	.000000
424	WHLSALE: COMM.-IND. MACH. EQUIP.-SUPP'S	.000034	.000049
425	WHLSALE: FARM MACHINERY AND EQUIPMENT	.001520	.002148
426	WHLSALE: PROF. EQUIP. & SUPPLIES	.000000	.000000
427	WHLSALE: EQUIP. & SUPP'S-SERVICE EST.'S	.000000	.000000
428	WHLSALE: MACHINERY,EQUIP.SUPPLIES,N.E.C	.000000	.000000
429	WHLSALE: METALS & MINERALS	.000076	.000107
430	WHLSALE: PETROLEUM & PETRO PRODUCTS	.013276	.018765
431	WHLSALE: SCRAP & WASTE MATERIALS	.000000	.000000
432	WHLSALE: MISC., N.E.C.	.013812	.019522
433	RETAIL: LUMBER AND BUILDING MATERIALS	.000000	.000000
434	RETAIL: PAINT, GLASS, WALLPAPER	.000000	.000000
435	RETAIL: HARDWARE & FARM EQUIPMENT	.000000	.000000
436	RETAIL: DEPARTMENT STORES	.000000	.000000
437	RETAIL: MAIL ORDER; VENDING MACHINES	.000000	.000000
438	RETAIL: VARIETY STORES	.000000	.000000
439	RETAIL: DIRECT SELLING ORG.'S	.000000	.000000
440	RETAIL: MISC. GENERAL MERCH. STORES	.000000	.000000
441	RETAIL: GROCERY STORES	.000000	.000000
442	RETAIL: MEAT AND FISH MARKETS	.000000	.000000
443	RETAIL: FRUIT & VEGETABLE STORES	.000000	.000000
444	RETAIL: CANDY,NUT, CONFECTIONARY STORES	.000000	.000000
445	RETAIL: BAKERIES	.000000	.000000
446	RETAIL: MISC. FOOD STORES, N.E.C.	.000000	.000000
447	RETAIL: NEW MOTOR VEHICLE DEALERS	.000000	.000000
448	RETAIL: USED MOTOR VEHICLE DEALERS	.000000	.000000
449	RETAIL: TIRE, BATTERY, ACCESS, DEALERS	.000136	.000116
450	RETAIL: GASOLINE SERVICE STATIONS	.000000	.000000

Appendix Table A. (continued)

NO.	SECTOR NAME	WHEAT COLUMN	BARLEY COLUMN
451	RETAIL: MISC. AIRCRAFT, MARINE & AUTO	.000000	.000000
452	RETAIL: MEN'S AND BOYS CLOTHING STORES	.000000	.000000
453	RETAIL: WOMEN READY TO WEAR STORES	.000000	.000000
454	RETAIL: WOMEN'S ACCESS.-SPECIALTY STORE	.000000	.000000
455	RETAIL: CHILDREN'S-INFANTS WEAR STORES	.000000	.000000
456	RETAIL: FAMILY CLOTHING STORES	.000000	.000000
457	RETAIL: SHOE STORES	.000000	.000000
458	RETAIL: MISC. APPAREL STORES, N.E.C.	.000000	.000000
459	RETAIL: FURNITURE, HOME FURNISH., EQUIP.	.000000	.000000
460	RETAIL: HOUSEHOLD APPLIANCE STORES	.000000	.000000
461	RETAIL: RADIO, TV AND MUSIC STORES	.000000	.000000
462	RETAIL: DRUGS AND PROPRIETARY STORES	.000000	.000000
463	RETAIL: LIQUOR STORES	.000011	.000010
464	RETAIL: BOOK AND STATIONERY STORES	.000000	.000000
465	RETAIL: SPORTING GOODS AND BICYCLE SHOP	.000000	.000000
466	RETAIL: JEWELRY STORES	.000000	.000000
467	RETAIL: FUEL AND ICE DEALERS	.000000	.000000
468	RETAIL: N.E.C.	.000000	.000000
469	BANKING	.006765	.006417
470	CREDIT AGENCIES	.000359	.000317
471	SECURITY & COMMIDITY BROKERS	.000002	.000001
472	INSURANCE CARRIERS	.002474	.001925
473	INSURANCE AGENTS & BROKERS	.000000	.000000
474	OWNER-OCCUPIED DWELLINGS	.000000	.000000
475	REAL ESTATE	.135325	.084352
476	HOTELS & LODGING PLACES	.000020	.000023
477	PERSONAL & REPAIR SERVICES	.000024	.000025
478	BEAUTY & BARBER SHOPS	.000000	.000000
479	MISC BUSINESS SERVICES	.007722	.009712
480	ADVERTISING	.000031	.000105
481	MISC PROFESSIONAL SERVICES	.001846	.001648
482	EATING & DRINKING PLACES	.000535	.000481
483	AUTO REPAIR & SERVICES	.003464	.003350
484	MOTION PICTURES	.000000	.000000
485	AMUSEMENT & RECREATION SERVICES	.000019	.000022
486	DOCTORS & DENTISTS	.000000	.000000
487	HOSPITALS	.000000	.000000
488	OTH MEDICAL & HEALTH SERVICES	.000007	.000008
489	EDUCATIONAL SERVICES	.000000	.000000
490	NONPROFIT ORGANIZATIONS	.000535	.000458
491	FED. GOVT. ENT.'S	.000000	.000000
492	ST/LOCAL GOVT. ENTERPRISES	.000000	.000000
493	ADMINISTRATIVE AUXILIARY	.000000	.000000
494	HOUSEHOLDS	.000000	.000000

Appendix Table B. The Disaggregated Impacts of a 50 Million Dollar Increase in the Final Demand for Wheat

	EMPLOYMENT	OUTPUT	WAGES	VALUE ADD
AGRICULTURE	908.9	55.043	7.203	13.225
DAIRY PROD., POULTRY, & EGGS	7.2	.235	.024	.022
MEAT ANIMALS & MISC. LIVESTOCK	45.2	2.372	.138	.193
FOOD GRAINS	848.8	52.010	6.969	12.899
FEED GRAINS	6.2	.380	.059	.086
SUGAR CROPS	.0	.002	.000	.001
MISCELLANEOUS CROPS	.7	.024	.004	.005
FOREST PROD.	.0	.001	.000	.000
GREENHOUSE & NURSERY PROD.	.8	.020	.008	.013
AGRI. SERV., FORESTRY, & FISH	50.9	.773	.346	.357
AGRI. SERVICES (07)	50.9	.767	.345	.354
FORESTRY (08)	.0	.005	.001	.003
FISHING,HUNTING,&TRAPPING (09)	.0	.001	.000	.001
MINING	15.2	2.433	.423	1.561
METAL MINING (10)	.1	.005	.002	.003
ANTHRACITE MINING (11)	.0	.000	.000	.000
BITUM. COAL & LIGNITE (12)	.6	.075	.023	.047
OIL & GAS EXTRACTION (13)	8.8	1.782	.251	1.155
NONMETAL MIN.-EX. FUELS (14)	5.8	.571	.148	.356
CONSTRUCTION	42.6	1.359	1.010	1.054
GENERAL BLDG. CONTRACTORS (15)	.0	.000	.000	.000
HEAVY CONST. CONTRACTORS (16)	.0	.000	.000	.000
SPECIAL TRADE CONTRACTORS (17)	42.6	1.359	1.010	1.054
MANUFACTURING	24.4	8.720	.464	1.470
FOOD & KINDRED PROD. (20)	4.5	.758	.081	.139
TOBACCO MANUFACTURES (21)	.0	.000	.000	.000
TEXTILE MILL PROD. (22)	.0	.000	.000	.000
APPAREL & OTHER PROD. (23)	.2	.006	.002	.003
LUMBER & WOOD PROD. (24)	.4	.037	.007	.013
FURNITURE & FIXTURES (25)	.0	.002	.001	.001
PAPER & ALLIED PROD. (26)	.1	.007	.002	.003
PRINTING & PUBLISHING (27)	4.1	.255	.052	.082
CHEMICALS & ALLIED PROD. (28)	4.8	.736	.082	.217
PETROLEUM & COAL PROD. (29)	6.1	6.636	.171	.901
RUBBER & MISC. PLASTICS (30)	.0	.000	.000	.000
LEATHER & LEATHER PROD. (31)	.0	.000	.000	.000
STONE, CLAY, & GLASS (32)	.7	.053	.012	.021
PRIMARY METAL PROD. (33)	.1	.017	.003	.005
FABRICATED METAL PROD. (34)	.4	.028	.007	.011
MACHINERY, EXCEPT ELEC. (35)	2.6	.161	.037	.068
ELECTRIC & ELEC. EQUIP. (36)	.0	.002	.001	.001
TRANSPORTATION EQUIPMENT (37)	.2	.010	.002	.003
INSTRUMENTS & REL. PROD. (38)	.0	.001	.000	.001
MISC. MANUFACTURING IND'S (39)	.2	.009	.002	.003
TRANSPORT., COMM. & PUBLIC UTILITIES	33.3	2.902	.736	1.467
RAILROAD TRANSPORTATION (40)	6.9	.426	.202	.180

Note: Output, Wages, and Value Added in millions of dollars.

Appendix Table B. (continued)

	EMPLOYMENT	OUTPUT	WAGES	VALUE AD
LOCAL PASS. TRANSIT (41)	2.7	.113	.030	.080
TRUCKING & WAREHOUSING (42)	7.7	.410	.157	.256
WATER TRANSPORTATION (44)	.1	.008	.002	.003
TRANSPORTATION BY AIR (45)	1.0	.053	.019	.031
PIPE LINES-EX. NAT. GAS (46)	.3	.065	.009	.045
TRANSPORTATION SERVICES (47)	.5	.010	.006	.006
COMMUNICATION (48)	7.1	.510	.152	.361
ELEC.,GAS,&SANITARY SERV. (49)	7.6	1.306	.159	.454
WHOLESALE	61.7	2.546	1.079	1.719
WHLSALE-DURABLE-GOODS (50)	21.3	1.003	.416	.692
WHLSALE-NONDURABLE GOODS (51)	40.4	1.544	.663	1.027
RETAIL TRADE	110.3	2.632	1.197	1.724
BLDG. MAT.-GARDEN SUPPLY (52)	5.3	.146	.082	.116
GENERAL MERCH. STORES (53)	13.9	.279	.156	.225
FOOD STORES (54)	9.6	.217	.122	.175
AUTO. DEALERS-SERV. STAT. (55)	12.5	.532	.297	.423
APPAREL & ACCESS. STORES (56)	7.6	.134	.074	.104
FURNITURE & HOME FURNISH. (57)	5.0	.126	.074	[illegible]
EATING & DRINKING PLACES (58)	34.7	.852	.240	.460
MISCELLANEOUS RETAIL (59)	14.6	.339	.152	[illegible]
FINANCE, INS., & REAL ESTATE	100.2	11.437	1.450	8.946
BANKING (60)	24.2	.878	.433	.572
CREDIT AGENCIES EX. BANKS (61)	3.6	.146	.071	.076
SECURITY, COMM. BROKERS (62)	.5	.034	.020	.025
INSURANCE CARRIERS (63)	6.0	.271	.116	.126
INS. AGENTS, BROKERS (64)	2.1	.109	.039	.067
REAL ESTATE (65)	52.5	8.322	.631	6.648
COMB. REAL ESTATE, INS. (66)	10.4	1.645	.125	1.314
HOLDING-OTH. INV.. OFF'S (67)	.9	.033	.016	.017
SERVICES	115.8	3.639	1.328	2.095
HOTELS & OTHER LODGING (70)	9.0	.171	.059	.079
PERSONAL SERVICES (72)	7.7	.242	.105	.145
BUSINESS SERVICES (73)	14.0	.543	.215	.334
AUTO REPAIR,SERV.,GARAGES (75)	6.7	.654	.105	[illegible]
MISC. REPAIR SERVICES (76)	3.9	.142	.060	.091
MOTION PICTURES (78)	1.2	.018	.007	.008
AMUSEMENT & RECREATION (79)	4.2	.067	.037	[illegible]
HEALTH SERVICES (80)	32.1	.885	.414	.528
LEGAL SERVICES (81)	2.2	[illegible]	.050	.076
EDUCATIONAL SERVICES (82)	7.6	.102	.035	.053
SOCIAL SERVICES (83)	12.7	.139	.060	.083
MUSEUMS,BOTAN-ZOO.GARDENS (84)	.1	.001	.000	[illegible]
MEMBERSHIP ORGANIZATIONS (86)	10.1	.151	.048	.074
MISCELLANEOUS SERVICES (89)	5.7	.266	.132	[illegible]
GOVERNMENT	1.1	.220	.052	[illegible]
ADMIN. AUXILIARY	.0	.000	.000	[illegible]
TOTAL	1456.[illegible]	21.764	15.288	[illegible]
MULTIPLIERS	1.797	1.815	2.282	[illegible]

Appendix Table C. The Disaggregated Impacts of a 20 Million Dollar Increase in the Final Demand for Barley.

	EMPLOYMENT	OUTPUT	WAGES	VALUE ADD
AGRICULTURE	369.3	22.080	3.303	4.804
DAIRY PROD., POULTRY, & EGGS	12.3	.401	.042	.049
MEAT ANIMALS & MISC. LIVESTOCK	19.9	1.048	.061	.085
FOOD GRAINS	.2	.009	.001	.002
FEED GRAINS	336.1	20.594	3.192	4.659
SUGAR CROPS	.0	.001	.000	.000
MISCELLANEOUS CROPS	.5	.019	.004	.004
FOREST PROD.	.0	.000	.000	.000
GREENHOUSE & NURSERY PROD.	.3	.008	.003	.005
AGRI. SERV., FORESTRY, & FISH	19.6	.298	.133	.138
AGRI. SERVICES (07)	19.6	.296	.133	.137
FORESTRY (08)	.0	.002	.000	.001
FISHING,HUNTING,&TRAPPING (09)	.0	.000	.000	.000
MINING	7.2	1.096	.199	.701
METAL MINING (10)	.0	.003	.001	.002
ANTHRACITE MINING (11)	.0	.000	.000	.000
BITUM. COAL & LIGNITE (12)	.2	.033	.010	.021
OIL & GAS EXTRACTION (13)	3.6	.734	.103	.476
NONMETAL MIN.-EX. FUELS (14)	3.3	.326	.085	.203
CONSTRUCTION	14.8	.472	.350	.366
GENERAL BLDG. CONTRACTORS (15)	.0	.000	.000	.000
HEAVY CONST. CONTRACTORS (16)	.0	.000	.000	.000
SPECIAL TRADE CONTRACTORS (17)	14.8	.472	.350	.366
MANUFACTURING	11.9	3.847	.224	.677
FOOD & KINDRED PROD. (20)	2.1	.387	.139	.069
TOBACCO MANUFACTURES (21)	.0	.000	.000	.000
TEXTILE MILL PROD. (22)	.0	.000	.000	.000
APPAREL & OTHER PROD. (23)	.1	.003	.001	.001
LUMBER & WOOD PROD. (24)	.2	.017	.003	.006
FURNITURE & FIXTURES (25)	.0	.001	.000	.000
PAPER & ALLIED PROD. (26)	.0	.003	.001	.001
PRINTING & PUBLISHING (27)	1.8	.113	.023	.036
CHEMICALS & ALLIED PROD. (28)	3.2	.465	.056	.141
PETROLEUM & COAL PROD. (29)	2.5	2.728	.070	.370
RUBBER & MISC. PLASTICS (30)	.0	.000	.000	.000
LEATHER & LEATHER PROD. (31)	.0	.000	.000	.000
STONE, CLAY, & GLASS (32)	.4	.027	.006	.010
PRIMARY METAL PROD. (33)	.1	.008	.001	.002
FABRICATED METAL PROD. (34)	.2	.012	.003	.005
MACHINERY, EXCEPT ELEC. (35)	1.2	.073	.017	.031
ELECTRIC & ELEC. EQUIP. (36)	.0	.001	.000	.000
TRANSPORTATION EQUIPMENT (37)	.1	.005	.001	.001
INSTRUMENTS & REL. PROD. (38)	.0	.001	.000	.000
MISC. MANUFACTURING IND'S (39)	.1	.004	.001	.001
TRANSPORT. & PUBLIC UTILITIES	16.8	1.397	.365	.697
RAILROAD TRANSPORTATION (40)	3.2	.196	.093	.106

Note: Output, Wages, and Value Added in millions of dollars.

Appendix Table 6. (continued)

	EMPLOYMENT	OUTPUT	WAGES	VALUE AD[illegible]
LOCAL PASS. TRANSIT (41)	1.2	.051	.014	[illegible]
TRUCKING & WAREHOUSING (42)	4.5	.256	.098	[illegible]
WATER TRANSPORTATION (44)	.1	.004	.003	[illegible]
TRANSPORTATION BY AIR (45)	.4	.024	.009	.014
PIPE LINES-EX. NAT. GAS (46)	.1	.027	.004	.018
TRANSPORTATION SERVICES (47)	.2	.004	.003	[illegible]
COMMUNICATION (48)	2.9	.212	.063	.149
ELEC.,GAS,&SANITARY SERV. (49)	4.2	.623	.082	.209
WHOLESALE	32.2	1.318	.559	.857
WHLSALE-DURABLE-GOODS (50)	10.7	.507	.209	.347
WHLSALE-NONDURABLE GOODS (51)	21.4	.811	.350	.510
RETAIL TRADE	48.5	1.157	.527	.759
BLDG. MAT.-GARDEN SUPPLY (52)	2.3	.064	.036	.051
GENERAL MERCH. STORES (53)	6.1	.123	.069	.099
FOOD STORES (54)	4.2	.095	.053	.077
AUTO. DEALERS-SERV. STAT. (55)	8.6	.234	.131	.186
APPAREL & ACCESS. STORES (56)	3.4	.059	.037	.046
FURNITURE & HOME FURNISH. (57)	2.2	.055	.033	.045
EATING & DRINKING PLACES (58)	15.2	.377	.105	.162
MISCELLANEOUS RETAIL (59)	6.5	.149	.067	.093
FINANCE, INS., & REAL ESTATE	31.2	3.190	.472	2.476
BANKING (60)	9.7	.353	.174	.271
CREDIT AGENCIES EX. BANKS (61)	1.5	.062	.030	.032
SECURITY, COMM. BROKERS (62)	.2	.014	.008	.010
INSURANCE CARRIERS (63)	2.1	.096	.041	.045
INS. AGENTS, BROKERS (64)	.7	.039	.014	.024
REAL ESTATE (65)	13.8	2.181	.165	1.742
COMB. REAL ESTATE, INS. (66)	2.7	.431	.033	.344
HOLDING-OTH. INV.. OFF'S (67)	.3	.014	.007	.007
SERVICES	51.0	1.599	.585	.921
HOTELS & OTHER LODGING (70)	3.5	.076	.026	.035
PERSONAL SERVICES (72)	3.4	.105	.046	.043
BUSINESS SERVICES (73)	6.6	.255	.102	.158
AUTO REPAIR,SERV.,GARAGES (75)	2.6	.278	.044	.128
MISC. REPAIR SERVICES (76)	1.8	.069	.028	.042
MOTION PICTURES (78)	.5	.009	.003	.004
AMUSEMENT & RECREATION (79)	1.8	.030	.017	.019
HEALTH SERVICES (80)	14.0	.436	.184	.245
LEGAL SERVICES (81)	.9	.041	.020	.031
EDUCATIONAL SERVICES (82)	3.3	.045	.015	[illegible]
SOCIAL SERVICES (83)	5.4	.081	.026	[illegible]
MUSEUMS,BOTAN-ZOO.GARDENS (84)	.0	.000	.000	.000
MEMBERSHIP ORGANIZATIONS (86)	4.4	.065	.021	[illegible]
MISCELLANEOUS SERVICES (89)	2.3	.108	.053	.081
GOVERNMENT	1.6	.174	.025	[illegible]
ADMIN. AUXILIARY	.0	.000	.000	.000
TOTAL	[illegible]	36.626	[illegible]	[illegible]
MULTIPLIERS	1.851	1.831	2.175	[illegible]

Appendix Table D. The Simulated Disaggregated Impacts of the Payment-In-Kind Program for Wheat in Montana, 1983.

	EMPLOYMENT	OUTPUT	WAGES	VALUE ADD
AGRICULTURE	-536.1	-31.783	-.410	-7.097
DAIRY PROD., POULTRY, & EGGS	-10.3	-.336	-.035	-.041
MEAT ANIMALS & MISC. LIVESTOCK	-84.0	-4.413	-.256	-.359
FOOD GRAINS	-429.2	-26.301	.000	-6.523
FEED GRAINS	-11.3	-.694	-.108	-.157
SUGAR CROPS	.0	-.002	.000	.000
MISCELLANEOUS CROPS	-.5	-.017	-.003	-.003
FOREST PROD.	.0	-.001	.000	.000
GREENHOUSE & NURSERY PROD.	-.7	-.018	-.007	-.012
AGRI. SERV., FORESTRY, & FISH	-98.5	-1.491	-.669	-.688
AGRI. SERVICES (07)	-98.4	-1.485	-.668	-.685
FORESTRY (08)	.0	-.005	-.001	-.003
FISHING,HUNTING,&TRAPPING (09)	.0	-.001	.000	-.001
MINING	-27.2	-4.329	-.752	-2.777
METAL MINING (10)	-.1	-.010	-.003	-.006
ANTHRACITE MINING (11)	.0	.000	.000	.000
BITUM. COAL & LIGNITE (12)	-.5	-.073	-.022	-.046
OIL & GAS EXTRACTION (13)	-15.5	-3.152	-.443	-2.043
NONMETAL MIN.-EX. FUELS (14)	-11.1	-1.094	-.284	-.682
CONSTRUCTION	-63.6	-2.020	-1.501	-1.566
GENERAL BLDG. CONTRACTORS (15)	.0	.000	.000	.000
HEAVY CONST. CONTRACTORS (16)	.0	.000	.000	.000
SPECIAL TRADE CONTRACTORS (17)	-63.6	-2.020	-1.501	-1.566
MANUFACTURING	-34.2	-14.498	-.686	-2.387
FOOD & KINDRED PROD. (20)	-3.7	-.718	-.067	-.124
TOBACCO MANUFACTURES (21)	.0	.000	.000	.000
TEXTILE MILL PROD. (22)	.0	.000	.000	.000
APPAREL & OTHER PROD. (23)	-.1	-.006	-.002	-.003
LUMBER & WOOD PROD. (24)	-.3	-.027	-.005	-.009
FURNITURE & FIXTURES (25)	.0	-.001	.000	.000
PAPER & ALLIED PROD. (26)	-.1	-.010	-.002	-.003
PRINTING & PUBLISHING (27)	-3.4	-.203	-.042	-.066
CHEMICALS & ALLIED PROD. (28)	-8.9	-1.286	-.159	-.395
PETROLEUM & COAL PROD. (29)	-10.8	-11.795	-.304	-1.602
RUBBER & MISC. PLASTICS (30)	.0	.000	.000	.000
LEATHER & LEATHER PROD. (31)	.0	.000	.000	.000
STONE, CLAY, & GLASS (32)	-.6	-.045	-.010	-.018
PRIMARY METAL PROD. (33)	-.2	-.026	-.005	-.008
FABRICATED METAL PROD. (34)	-.4	-.025	-.007	-.010
MACHINERY, EXCEPT ELEC. (35)	-5.4	-.338	-.077	-.143
ELECTRIC & ELEC. EQUIP. (36)	-.1	-.002	-.001	-.001
TRANSPORTATION EQUIPMENT (37)	-.1	-.007	-.002	-.002
INSTRUMENTS & REL. PROD. (38)	.0	-.001	.000	.000
MISC. MANUFACTURING IND'S (39)	-.1	-.007	-.002	-.002
TRANSPORT. & PUBLIC UTILITIES	-34.0	-3.188	-.728	-1.536
RAILROAD TRANSPORTATION (40)	-4.7	-.292	-.138	-.158

Note: Output, Wages, and Value Added in millions of dollars.

Appendix Table D. (continued)

	EMPLOYMENT	OUTPUT	WAGES	VALUE ADD
LOCAL PASS. TRANSIT (41)	-2.2	-.091	-.024	-.064
TRUCKING & WAREHOUSING (42)	-6.2	-.350	-.134	-.219
WATER TRANSPORTATION (44)	-.1	-.006	-.002	-.002
TRANSPORTATION BY AIR (45)	-1.0	-.052	-.019	-.031
PIPE LINES-EX. NAT. GAS (46)	-.5	-.115	-.015	-.079
TRANSPORTATION SERVICES (47)	-.4	-.008	-.005	-.005
COMMUNICATION (48)	-8.6	-.618	-.187	-.444
ELEC.,GAS,&SANITARY SERV. (49)	-10.4	-1.656	-.205	-.534
WHOLESALE	-116.5	-4.531	-1.978	-3.137
WHLSALE-DURABLE-GOODS (50)	-30.6	-1.454	-.598	-.988
WHLSALE-NONDURABLE GOODS (51)	-85.9	-3.076	-1.380	-2.149
RETAIL TRADE	-78.7	-1.881	-.835	-1.206
BLDG. MAT.-GARDEN SUPPLY (52)	-3.5	-.096	-.053	-.076
GENERAL MERCH. STORES (53)	-9.1	-.183	-.102	-.148
FOOD STORES (54)	-6.5	-.146	-.082	-.117
AUTO. DEALERS-SERV. STAT. (55)	-13.4	-.364	-.204	-.289
APPAREL & ACCESS. STORES (56)	-5.0	-.088	-.049	-.068
FURNITURE & HOME FURNISH. (57)	-3.3	-.083	-.049	-.068
EATING & DRINKING PLACES (58)	-27.9	-.690	-.192	-.297
MISCELLANEOUS RETAIL (59)	-10.0	-.230	-.104	-.144
FINANCE, INS., & REAL ESTATE	-58.7	-3.807	-1.007	-2.814
BANKING (60)	-31.3	-1.135	-.560	-.870
CREDIT AGENCIES EX. BANKS (61)	-3.0	-.122	-.059	-.064
SECURITY, COMM. BROKERS (62)	-.6	-.036	-.021	-.026
INSURANCE CARRIERS (63)	-7.9	-.355	-.152	-.165
INS. AGENTS, BROKERS (64)	-2.7	-.143	-.051	-.088
REAL ESTATE (65)	-10.5	-1.660	-.126	-1.326
COMB. REAL ESTATE, INS. (66)	-2.1	-.328	-.025	-.262
HOLDING-OTH. INV.. OFF'S (67)	-.7	-.027	-.013	-.014
SERVICES	-109.7	-3.809	-1.379	-2.222
HOTELS & OTHER LODGING (70)	-6.9	-.144	-.051	-.067
PERSONAL SERVICES (72)	-5.5	-.173	-.074	-.103
BUSINESS SERVICES (73)	-24.0	-.928	-.371	-.575
AUTO REPAIR,SERV.,GARAGES (75)	-7.3	-.773	-.124	-.356
MISC. REPAIR SERVICES (76)	-5.9	-.224	-.090	-.132
MOTION PICTURES (78)	-.9	-.014	-.005	-.006
AMUSEMENT & RECREATION (79)	-2.9	-.047	-.026	-.030
HEALTH SERVICES (80)	-21.4	-.655	-.277	-.398
LEGAL SERVICES (81)	-3.0	-.138	-.068	-.104
EDUCATIONAL SERVICES (82)	-5.1	-.068	-.023	-.034
SOCIAL SERVICES (83)	-10.6	-.158	-.050	-.078
MUSEUMS,BOTAN-ZOO.GARDENS (84)	-.1	-.001	.000	.000
MEMBERSHIP ORGANIZATIONS (86)	-8.5	-.126	-.040	-.062
MISCELLANEOUS SERVICES (89)	-7.8	-.360	-.178	-.270
GOVERNMENT	-3.7	-.424	-.059	-.164
ADMIN. & MILITARY	.0	.000	.000	.000
TOTAL	-1160.9	-71.761	-10.306	-25.597
MULTIPLIERS	1.675	1.808	2.617	2.527